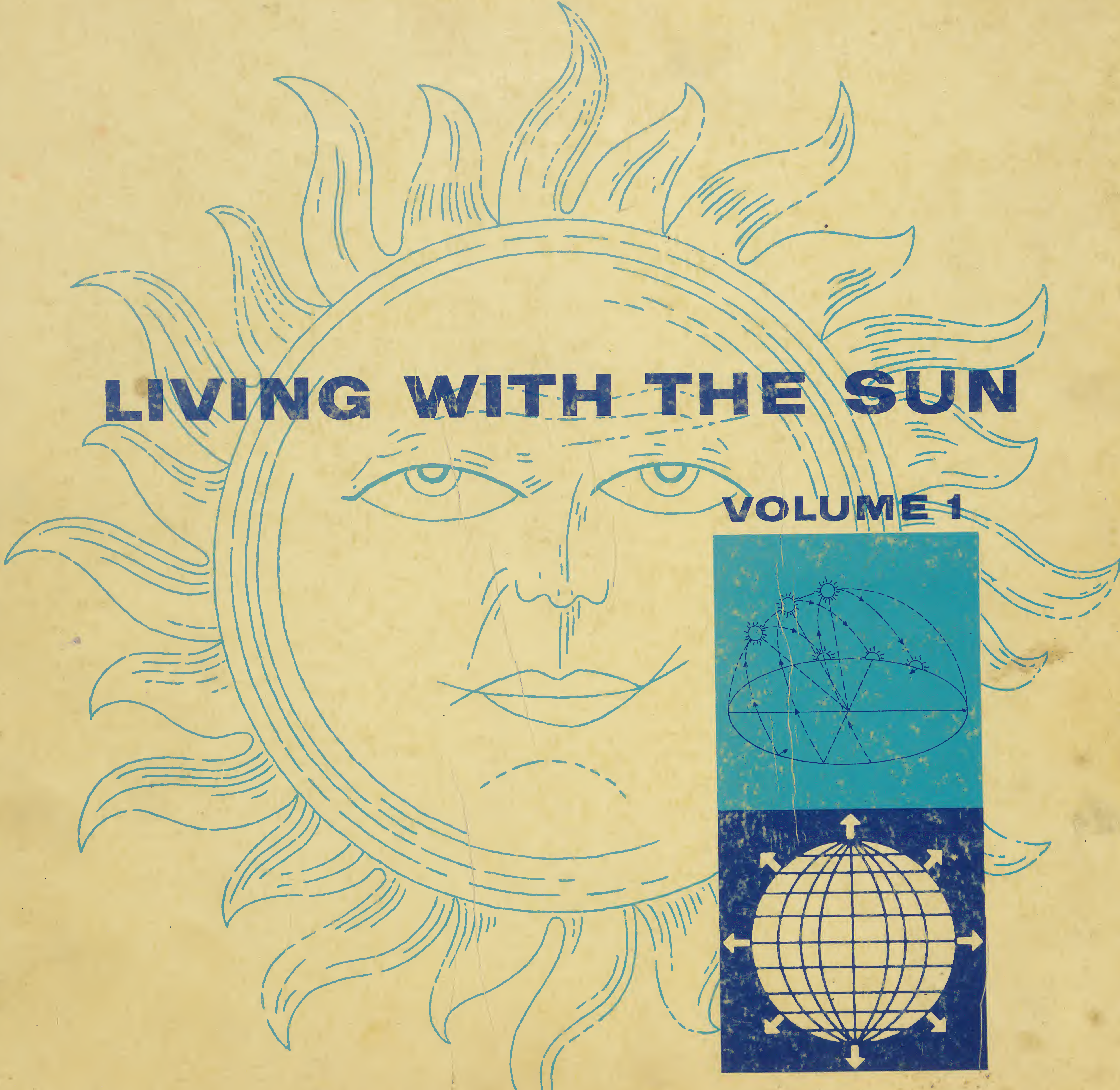
LIVING WITH THE SUN

VOLUME 1



MILES LEWIS.

LIVING WITH THE SUN

VOLUME 1

**Sixty Plans Selected from the Entries in the
1957 International Architectural Competition
To Design a Solar-Heated Residence**

The Association for Applied Solar Energy
3424 North Central Avenue
Phoenix, Arizona
1958

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PREFACE

James M. Hunter, F.A.I.A.
Boulder, Colorado

As Professional Advisor to the Association for Applied Solar Energy during its recent International Competition for the Design of a Solar House, it was my very rare privilege to write the program and to organize the conditions of a contest which encouraged the efforts of some 1600 architects from 36 nations. I hope that my efforts resulted in the fairness of opportunity to all competitors that I intended to maintain. It is obvious now that thirty days was not enough time for delivery to the United States from some parts of the world, and it is unfortunate that a few entries arrived after the judgment was over and so could not be included. I feel that the solutions to the problem of solar energy utilization demonstrated by the competitors can raise the living standards of us all and contribute immeasurably to man's comfort and well-being.

Almost all of the 130 final entries showed a sound basic concept of the problem, and many of them made real, worthwhile contributions to the science and art of utilizing the sun's energy for man's good.

The general high quality of the entries created a very real challenge for the jury members, who spent hours of time and effort in analyzing, studying, and evaluating their comparative worth with respect to the solar, the architectural, and the climatic and regional factors involved. No entry was slighted, and every consideration was given to the language barrier and to concepts stemming from pecularities of region, method, or cost. I was pleased and filled with admiration by the jury's diligence, fairness, and painstaking approach to their demanding and unusual task.

To me, the real worth of the competition was not in establishing five winners and choosing an architect to build a house, but rather in the impact of the concerted efforts, the sincere thinking, and the willingness to use one's skill and talent to the common good of all mankind. To me, this was a fine and a commendable example, on the part of the architectural profession throughout the world, of international cooperation, understanding, and contribution to a problem which confronts us in every part of the globe.

On behalf of the jurors, the Association for Applied Solar Energy, and myself, I wish to thank sincerely the fellow members of my profession for their interest and for the time spent in their efforts. I wish also to thank the Union Internationale des Architects, the American Institute of Architects, and the many architectural societies throughout the world for their help in translating, publicizing, and fostering the interests of the entire architectural profession. I can only hope that the interests so stimulated will proceed to fruitful ends in the solution of the particular problems of the sun in their own countries and climates. It is the sincere hope of the Association for Applied Solar Energy that the results of the experimentation in the use of the world's only inexhaustible supply of free energy, thus prompted, will be made available to the Association for dissemination to interested persons all over the globe.

November, 1957

James Hunter shows the winning design to the jurors: (left to right) Pietro Belluschi, Thomas Creighton, Carlos Contreras, Nathaniel Owings, and James Elmore.

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INTRODUCTION:

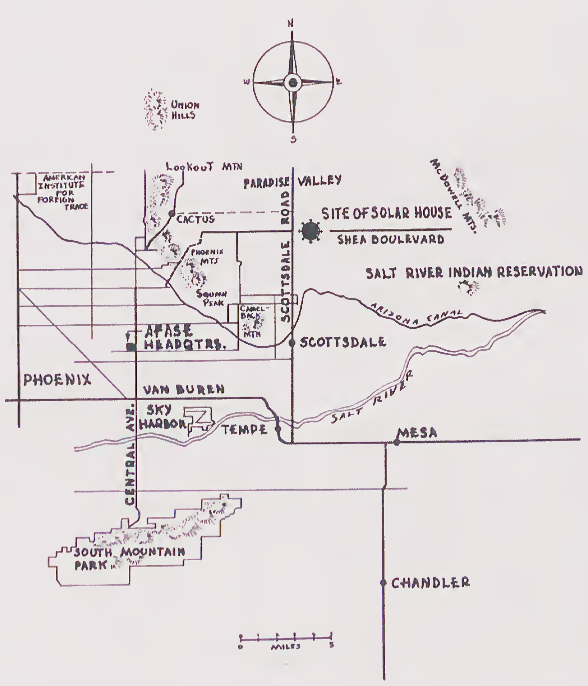
The International Solar House Architectural Competition

The 1957 Architectural Competition was conducted by the Association for Applied Solar Energy, with the cooperation of the Phoenix Association of Home Builders, for the purpose of stimulating public interest in the utilization of the sun's energy for man's benefit in his living environment. The residence designed by first-prize winner Peter Lee will be built at the Sundown Ranch Estates near Phoenix and will become a "living laboratory" for the study of solar heating and cooling. It will also form the center of interest at a symposium for scientists interested in the collection and utilization of solar energy, which will be held in Phoenix in the fall of 1958.

This volume is being published by the Association so that the members of the architectural profession and others interested in solar heating can learn of the ideas proposed by sixty of the entrants. A public exhibition of some of the drawings was held in the Phoenix Public Library immediately after the completion of the competion, and this volume may be regarded as an extension of that exhibition. It is the intent of the Association to give full credit to the architects of each entry, and the comments which are published at the end of the book are taken in part from the descriptive material submitted by the authors themselves, in part from comments made by the jury, and, finally, from the writer's study of each design. Those who wish to make use of these designs are asked to communicate with the Association, and their request will then be transmitted to the architect of the design in which they are interested.

In announcing the competition, the Association stated that the following money prize awards would be made: (a) 1st prize, $2,500; (b) 2nd prize, $1,500; (c) 3rd prize, $1,000; (d) 4th prize, $500; (e) 5th prize, $500. Provision was also made for the selection of other outstanding designs to receive honorable mention. The five prize-winning awards are presented on pages 1 through 5, and the designs which won honorable mention are presented on pages 6, 7, and 8. The 52 designs which make up the rest of the volume are presented in alphabetical order.

FIG. 1 — Map of the Phoenix area showing site of the solar-heated house.



The Program for competition was prepared by James M. Hunter, F.A.I.A., of Boulder, Colo., who served as Professional Advisor. Much of the subject matter of this introduction has been condensed from the Program.

The jury which selected the winning designs consisted of the following members:

A. Pietro Belluschi, F.A.I.A.
Dean of Architecture and Planning, Massachusetts Institute of Technology, Cambridge, Mass.

B. Carlos Contreras
Honorary Fellow, American Institute of Architects
Practising Architect of Mexico City, Mexico

C. Thomas H. Creighton, A.I.A.
Editor of *Progressive Architecture,* New York, N.Y.

D. James W. Elmore, A.I.A.
Practising Architect of Phoenix, Ariz.

E. Nathaniel Owings, F.A.I.A.
Practising Architect of San Francisco, Calif.

The jury met at the Grand Canyon on September 13 and spent three days in considering the 115 drawing which had reached the Professional Advisor before the specified closing date, August 15, 1957. Dean Belluschi was selected by the jury as their chairman, and his report is given on page vi.

Eligibility to compete was determined by registration to practice architecture in the home state or nation of the applicant, or by association with a qualified architect.

Communications between anonymous competitors and the Professional Advisor were answered by sending a copy of such questions, and the reply thereto, to all competitors. Complete anonymity of drawings was maintained, and neither the Professional Advisor nor the members of the jury were aware of the identity of any competitor until the jury had reached its decision.

In accordance with the terms of the competition, the original drawings have been accessioned in the library of the Association for Applied Solar Energy in Phoenix, where they will be available for study and research.

The Program contained maps and diagrams showing the Phoenix area (Fig. 1), the region where the house will be built, and the actual plot plan (Fig. 2). Climatological data for Phoenix, recorded during the year 1956 by the Phoenix Weather Bureau, is given in Fig. 3. The program also included a solar analysis and a thermal analysis for the arid southwest area which were originally compiled by *House Beautiful* and published in the March 1950 issue of the *Bulletin of the A.I.A.*

The program further specified that the cubic content of the residence should not exceed 20,000 cu ft, and the enclosed floor area should not exceed 2,000 sq ft, exclusive of carports, sheltered terraces, etc. It was intended that the total cost of the residence, exclusive of swimming pool, septic tanks, and landscaping, should not exceed $30,000. In this amount was included a $3,000 budget for solar equipment and solar cooling devices, and for their installation.

Mandatory provisions of the Program provided that all of the necessary drawings should be mounted, composed according to the choice of the competitor, on a single mount of tempered hardboard, 40 in. by 40 in. (or 1 m) square. The following drawings were required:

A. Plot plan at 1/32 in. equals 1 ft
B. Floor plans at 1/4 in. equals 1 ft

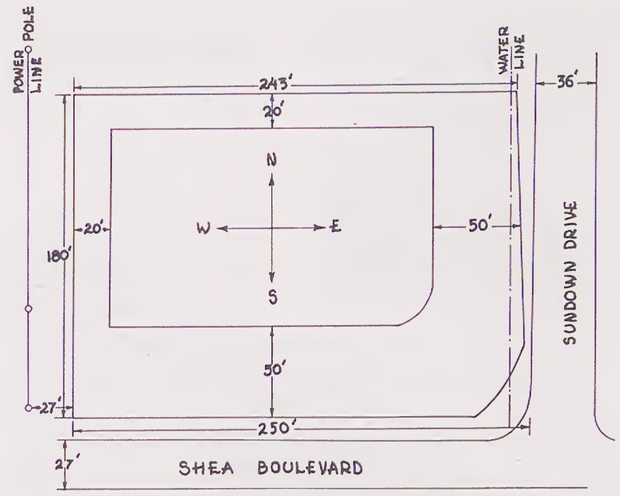


FIG. 2 — Plot for proposed solar-heated residence. The site is located on Shea Boulevard, one-half mile east of Scottsdale Road, in the Sundown Ranch Estates. The town of Scottsdale lies five miles to the south, and the center of metropolitan Phoenix is ten miles south and west.

C. All elevations at 1/4 in. equals 1 ft
D. One transverse and one longitudinal section through the building at 1/4 in. equals 1 ft
E. A perspective drawing from whatever point of view the competitor might select, at a scale of 1/4 in. equals 1 ft through the closest defining wall surface
F. Cubage diagram

In addition, an explanation of the design and proposed method of operation of the solar heating equipment, with a statement of the estimated heat loss and heat gain, was required to be submitted on no more than two sheets of paper, 8½ in. by 11 in. Design weather conditions for Phoenix were:

Winter: 75°F inside, 32°F outside
Summer: 80°F inside, 106°F outside

Requirements of the building (mandatory): The Program, in outlining the general nature of the residence, stated that it should be designed to accommodate adequately a typical Phoenix family, consisting of a husband and wife and two children. The historical and archeological background of the area, while interesting to the occupants of the residence, was not intended to influence the house stylistically; rather, it was expected that the house would express itself in terms of this era's techniques, materials, and concepts. The occupants of the house, having great respect for the sun and its influence on their way of life, would feel strongly that the energy of the sun should be harnessed for the purpose of heating and eventually cooling the house, and also that it should be controlled indirectly for their comfort, enjoyment, and well-being.

It was expected that sufficient solar-collecting area would be provided to heat the house, the domestic hot water supply, and the swimming pool. Since solar-operated refrigeration equipment is not yet available commercially, it is understood that mechanical refrigeration will be used at the outset to provide the air conditioning which is absolutely essential for comfortable existence in central Arizona. In addition, it was contemplated that the refrigeration equipment would also be used as a heat pump during the winter season to provide auxiliary heat.

Although the competitor was not limited in his selection of the method of collecting and utilizing solar energy, he was expected to commit the design of the house to a particular system of collection, providing: (a) adequate area for the installation of the solar collecting device; (b) adequate means for the movement of the solar-heated fluid to the storage unit; and (c) adequate space for storage of solar energy.

The Program classified the current methods of using solar energy for space heating under the following headings:

1. Liquid Transport Devices: Here water or other liquid is used as the collecting medium and pumped through tubes attached to surfaces exposed directly to the sun's rays to heat the liquid. The heated liquid is then led to a storage tank and used for domestic purposes to heat various types of radiators, radiant panel coils, air heating coils, or as a source of energy by extracting the heat from the liquid by means of a heat pump.
2. Gaseous Transport Devices: Here air or other gas is used as a vehicle to collect the solar heat by means of forcing it through channels, between louvered fins, or under heat-absorbing materials exposed to the direct rays of the sun. The heated air is then used directly for heating on the principle of the warm air furnace or run through storage devices consisting of materials with acceptably high specific gravity and specific heat, such as coarse hard gravel, or materials which will absorb heat by change of state, such as unstable salts (Glauber's salts). The air flow is then reversed to withdraw the heat from the storage medium for its intended use during those hours when the sun is not effective.
3. Combination Systems: In these systems both liquids and gases flow through the solar collectors, thereby providing domestic hot water and heated air for space-heating purposes.

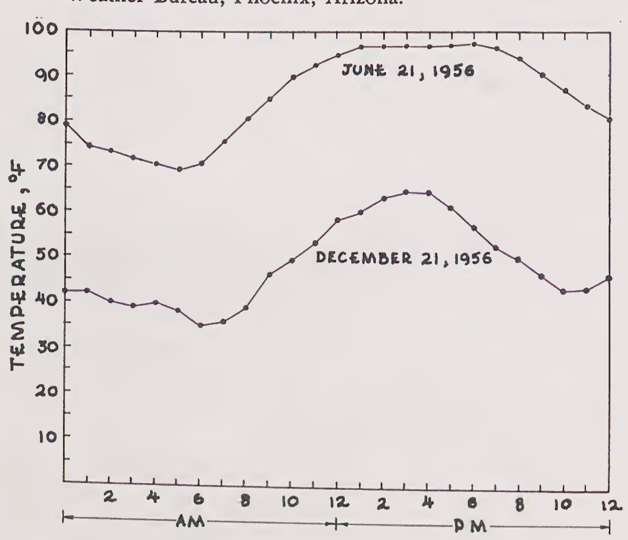
In addition to the solar energy being collected and stored for direct use in heating and cooling the project, it was felt that the sun should be controlled to create a climatic environment by the design of the residence itself: by orientation, deformation of the volume of the building, the use of color, texture, movable louvers, shade-creating devices, etc.

In addition to the budget set up for the project, a swimming pool will be provided with a capacity of 16,000 gal of water and a surface area of 500 sq ft complete with chlorinating and filtering devices. It was the competitors' responsibility to locate the pool and define its shape to the best advantage of both the building and the total development, and to devise a scheme for tempering the water by sheltering and shading devices.

The technical data on solar house heating which is given on the following pages was reproduced from the Program to serve as an introduction to the subject and to give other useful data. The bibliography given on page xii lists some of the outstanding papers and books on the subject of solar space heating.

John I. Yellott
Executive Director
Association for Applied Solar Energy

FIG. 4 — Hourly temperatures, June 21 and December 21, U.S. Weather Bureau, Phoenix, Arizona.



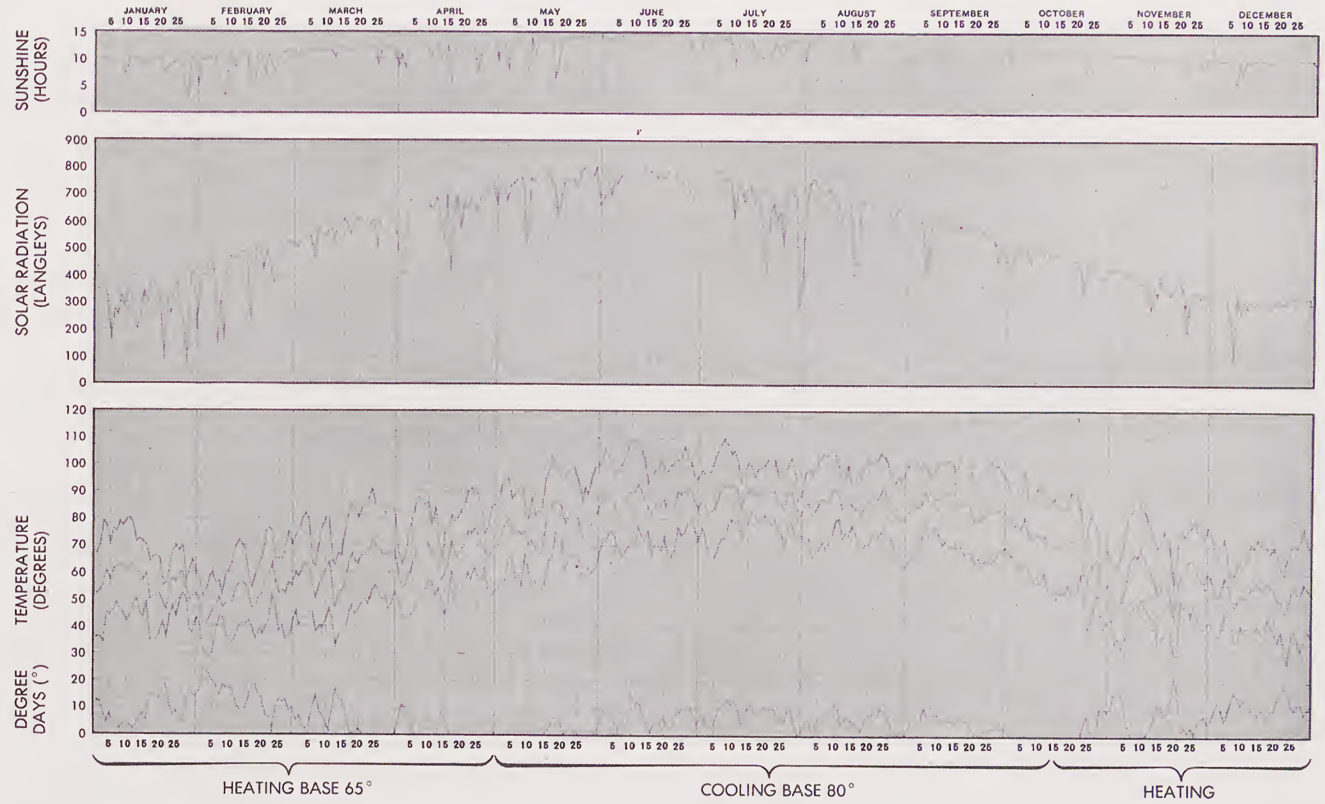


FIG. 3 — Climatological data, Phoenix, Arizona, 1956.

TECHNICAL NOTES ON SOLAR HEATING

Phoenix Area Climatology

The charts shown on this page constitute the basic data for the design of heating and cooling equipment in the Phoenix area. Fig. 3 was prepared from data supplied by the U. S. Weather Bureau. At the site of the proposed residence, the latitude and longitude are approximately 33° 33′ north and 112° west, respectively, and the elevation is 1420 ft. Arizona remains on Mountain Standard Time throughout the entire year.

The actual daily temperatures — high, average, and low — which were encountered in Phoenix during 1956 are shown in Fig. 3, as are daily values of the total solar radiation on a horizontal surface. To convert from "langleys," the scientific units of radiation measurement (gm-cal per sq cm), to engineering units (Btu per sq ft), a factor of 3.69 is used. On December's coldest days the insolation rarely fell below 1110 Btu per sq ft per day, while in midsummer it rose to almost 3000 Btu per sq ft per day. Hourly variation of dry bulb temperatures for twenty-four hour periods at midsummer and midwinter are shown in Fig. 4.

Design Considerations

The design of solar heat collection apparatus is still in its infancy. The following comments were originally intended to assist the competitor in proportioning the collection surface which must be provided to perform the following assigned functions:

1. Heating the domestic water supply
2. Space-heating the residence during average winter weather
3. Heating the water in the swimming pool

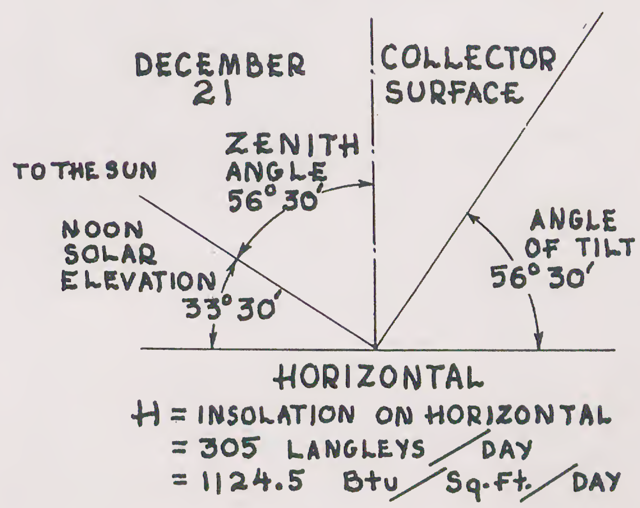
Regardless of the collection system which the competitor selected, he was faced with the problems of providing enough solar-exposed surface to accomplish the functions listed above and, at the same time, of expressing the device architecturally.

If the collection surface is horizontal, the amount of solar energy which is available can be found from Fig. 3. If the surface is tilted so that it is normal to the sun's rays on December 21, as shown in Fig. 5, the energy which can be collected per square foot is at its theoretical maximum. At tilt angles smaller or larger than 56°30′, the available radiation intensity drops off proportionately, as shown in Fig. 6. This chart gives conservative values of the slope factor, which is the ratio between the insolation intensity for a collector inclined at any given angle of tilt and the insolation on a horizontal surface at the same time and place. Somewhat higher values of this factor are given in Ref. 2 (p. 70),* but experience in the Southwest indicates that Fig. 6 gives more accurate values for the Phoenix area.

Efficiency of collection of the incident radiation is subject to a large number of variables, and conservative values are suggested in Table I, which is taken from Ref. 9, p. 197. Efficiencies for well-insulated collectors with a single glass cover plate should run from 50 to 60 per cent on average winter days.

*For references, see bibliography on page xii.

FIG. 5 — Solar elevation and zenith angles for December 21.



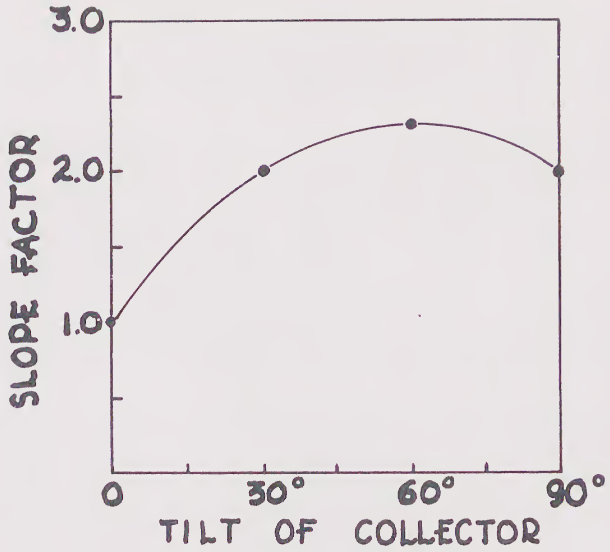


FIG. 6 — Slope factor vs. collector tilt.

TABLE I
Daily Efficiency for a Solar Collector
42° N. Latitude, January 15, partly cloudy day
Insolation taken as 1000 Btu per day per sq ft of horizontal surface. No loss from back of collector.
(Data from Ref. 3, p. 197)

Temperature difference between collector plate and average daily outdoor air temperature, °F	0	10	20	30	40	50	60
Daily collector efficiency, %							
One glass cover plate	86	79.8	72	63.6	55	45	35
Two glass cover plates	76	72.5	69	65	60	55	49

1. Domestic Water Heating

The domestic water heating system must supply some 200 gals of water per day, at 140°F. This represents a heat collection of about 117,000 Btu per day. If the tilt angle of the collector approaches the theoretical maximum, each square foot of surface will receive an average of 2000 Btu per day, and with a collection efficiency of 50 per cent, approximately 120 sq ft of surface will be needed. If the surface is horizontal, about 240 sq ft will be required.

Since there is no natural gas supply at the site of the residence, an electric immersion heater was acceptable as a solution to the problem of supplying auxiliary heat to the water system during prolonged periods of cloudy weather.

2. Space Heating

Space heating by solar heat collection and storage was expected to provide for the entire heating load during normal winter weather. If the competitor believed it necessary, a mechanical refrigerator of relatively small size was used as a heat pump (Ref. 4, p. 115-25) to supply the auxiliary energy which would be needed from time to time. This same equipment could be used for cooling the residence in the summer.

With a maximum floor area of 2000 sq ft and exceptionally good insulation, the heat loss for the residence should not exceed 55,000 Btu per hour when the design conditions of 75°F inside and 32°F outside are maintained. On a normal winter day, the outdoor temperature will average closer to 50°F and the heating requirement for the entire day will be about 700,000 Btu.

The area needed to obtain a collection of 700,000 Btu, assuming an efficiency of 60 per cent and an average horizontal insolation of 1000 Btu per sq ft per day, will be about 600 sq ft if the tilt approaches the theoretical optimum. For tilt angles from 30° to horizontal, the required area will increase up to a maximum of 1200 sq ft.

In the foregoing estimate, no credit has been taken for solar heat gain through south-facing windows, or in exposed surfaces of the house. This subject is discussed at length in Refs. 2 and 7.

The development and production of plastic materials with light transmission characteristics similar to those of glass has been announced during the past year. These materials, which are reported to have the ability to withstand weathering and to resist deterioration due to ultraviolet radiation, are now commercially available. Ref. 12 is suggested for more information on these materials.

The development and production of copper or aluminum panels in which the tubing is integral with the metal sheet has also been announced by several companies. In one production process, any desired tube pattern can be produced (Ref. 13) in panels of moderate size. In another process, the tubes must be straight, but the tube and sheet (Ref. 14) may be as long as needed. Fig. 7 shows a sketch of a collector using these new developments. Reflective insulation is used to minimize heat loss from the back of the plate.

Means must be provided for storing excess heat collected during the day for use at night and during periods of moderate duration when insolation is abnormally low. This subject has been considered at length by many authorities (Ref. 3, p. 57; Ref. 4, p. 115-25), but only two types of storage systems have been reduced to practice.

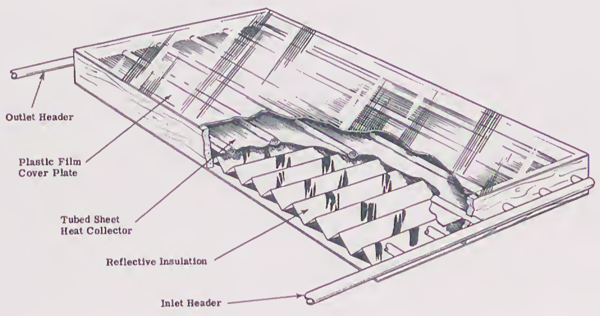
TABLE II
Properties of "Specific Heat" Storage Materials

	Specific Heat Btu per lb	Specific Weight lb per cu ft	Unit Heat Capacity Btu per cu ft per °F	
			No Voids	30% Voids
Water	1.00	62.4	62.4	------
Concrete	0.27	140.0	38.0	26.0
Rock	0.205	180.0	37.0	26.0
Brick	0.20	140.0	28.0	20.0
Aluminum	0.215	168.0	36.0	25.0
Iron	0.112	489.0	55.0	38.0

A. In the "specific heat" system, some fluid or solid substance is heated during the day and allowed to give off its excess heat at night. Properties of a number of heat storage materials are listed in Table II, which is adapted from Ref. 3, p. 54. A 5000-gal tank, containing 41,500 lb of water or other fluid of equal specific heat, will store a two-day heat supply, assuming that normal storage temperature is 120°F and the minimum useful temperature is 85°F. If rocks or some other solid material with a specific heat of 0.2 are used, about 100 tons would be needed.

B. The "heat of fusion" system in which materials change "state" within a usable temperature range has also been used for storage of solar heat. This subject is discussed at length in Ref. 4, p. 147-51. For example, Glauber's salt stored in containers or tubes has a considerably higher storage capacity per cubic foot than any of the "specific heat" materials.

FIG. 7 — Flat-plate collector.



3. Heating the Swimming Pool

The heat loss from an uncovered swimming pool in the Phoenix area in January can readily exceed 140 Btu per sq ft per hr. Assuming an average wind velocity of 5.2 mph, 50 per cent relative humidity, 53°F dry bulb temperature, and 78°F pool water temperature, the heat loss per sq ft per hr will be about 90 Btu by radiation, 20 Btu by evaporation, and 30 Btu by convection. If the pool is covered with an impervious, heat-absorbing material, radiation and evaporation loss can be virtually eliminated and the total heat loss reduced to the convection component. On a cloudy day, when the insolation is low, the heat loss for 500 sq ft of pool surface will be about 360,000 Btu. The cover will regain some of this during the day, but a collector area of about 300 sq ft, tilted to approach the theoretical optimum, will be needed to ensure a comfortable pool temperature throughout the winter. If the pool solar-collector surface is horizontal, it will require about 600 sq ft of area.

Scale of Drawings

The architectural plans which follow were reduced in size from the 39.6-in. square original to 14 in. square, i.e., 35.3 per cent. Therefore, the scale for the plan and elevation, which was originally specified as 1/4 in. per ft, has now become approximately 1/12 in. per ft.

OPENING STATEMENT
Of the Jury

This competition revealed the wealth of architectural possibilities inherent in the problem of utilizing solar energy for climate control in human habitation. The interest in this possibility was made evident by the number of architects throughout the world who made inquiries and wished to compete.

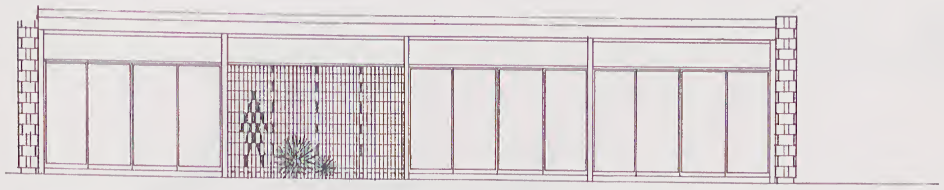
The standard of performance demonstrated by the entries was generally high, although no one scheme rose clearly into excellence. The novelty and challenge of the problem evidently acted as a stimulant to the imagination because there appeared a remarkable number of ideas which had validity, even though they were experimental in character. This fact was considered by the jury to be the main value of the competition.

Utilization of solar energy is still in its infancy, but all signs point to the growing importance of its development, particularly in certain sections of the world. The way in which architects will succeed in integrating it with the design of buildings and giving it aesthetic appeal will have a great effect on the rapidity with which it will receive general acceptance.

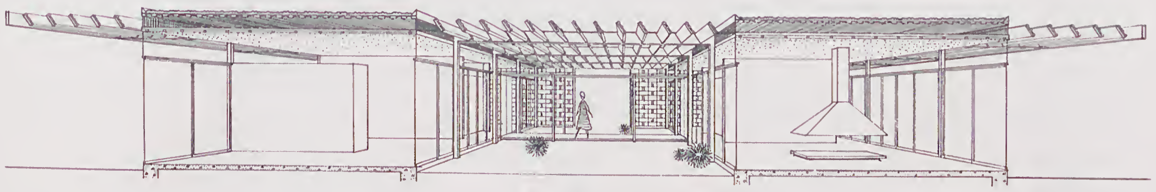
Basically, the solutions fell into two categories. In one of them, the solar collectors were assumed to be an integral part of the house, controlling and limiting its design. In the other, it was believed to be more desirable to keep the heat-collecting mechanism as a separate entity, thus allowing a more conventional design for the house and perhaps permitting mechanical controls which would be more amenable to sudden demands caused by varying outdoor temperatures. Which of the two categories will prove to contain the more practical and economical solution, only experience will tell. Certainly there was an abundance of solutions and ideas, warranting a continuation of our efforts in both categories.

Dean Pietro Belluschi
Massachusetts Institute of Technology
Chairman of the Jury

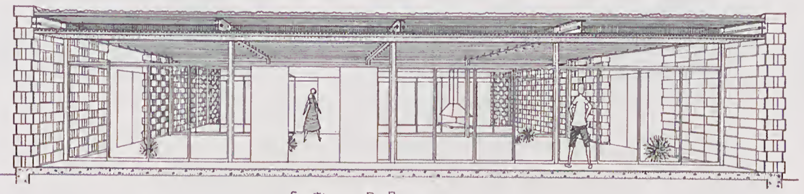
PETER R. LEE, Minneapolis, Minn. 1



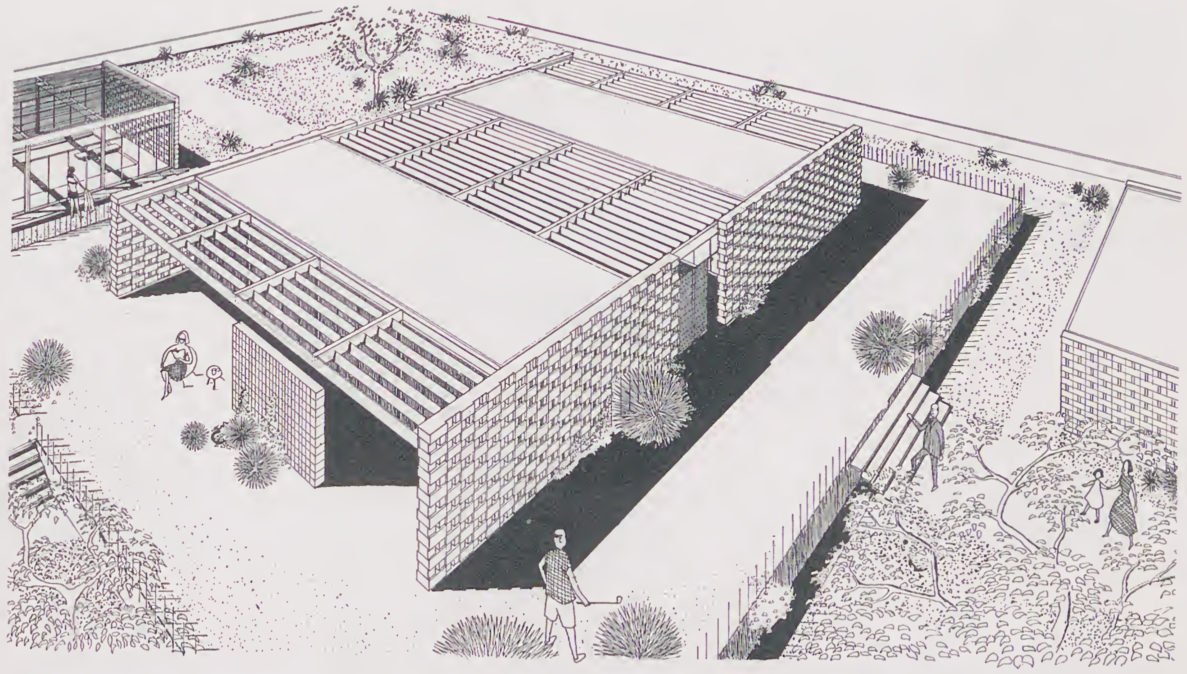
North Elevation

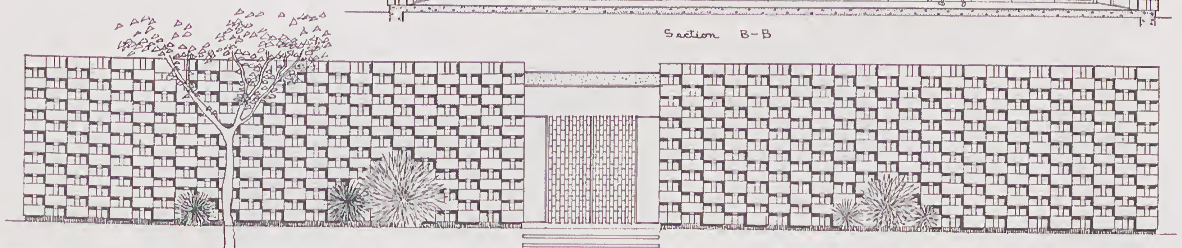


Section A–A

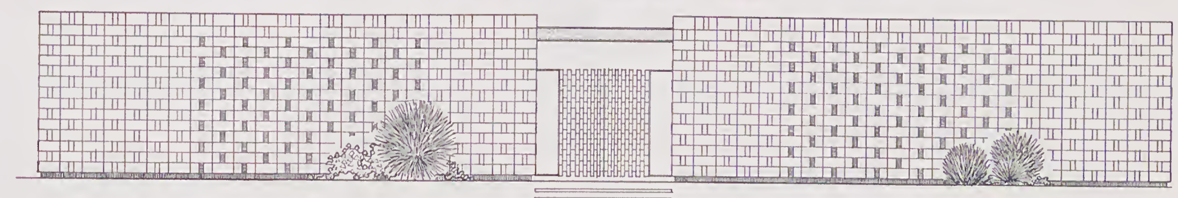


Section B–B

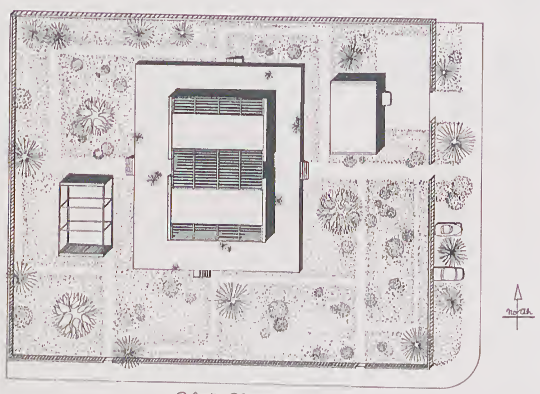




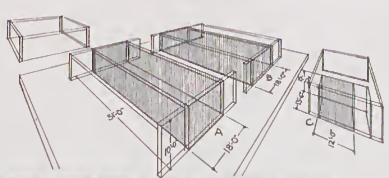
West Elevation



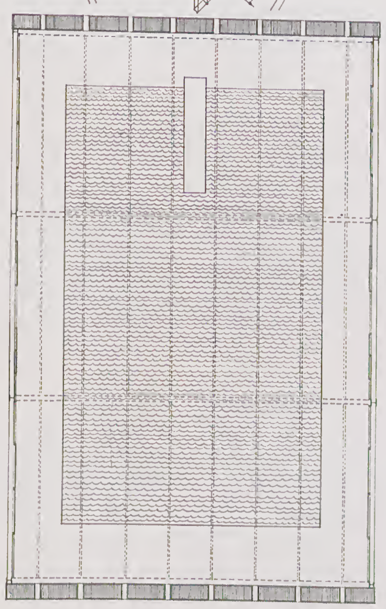
East Elevation



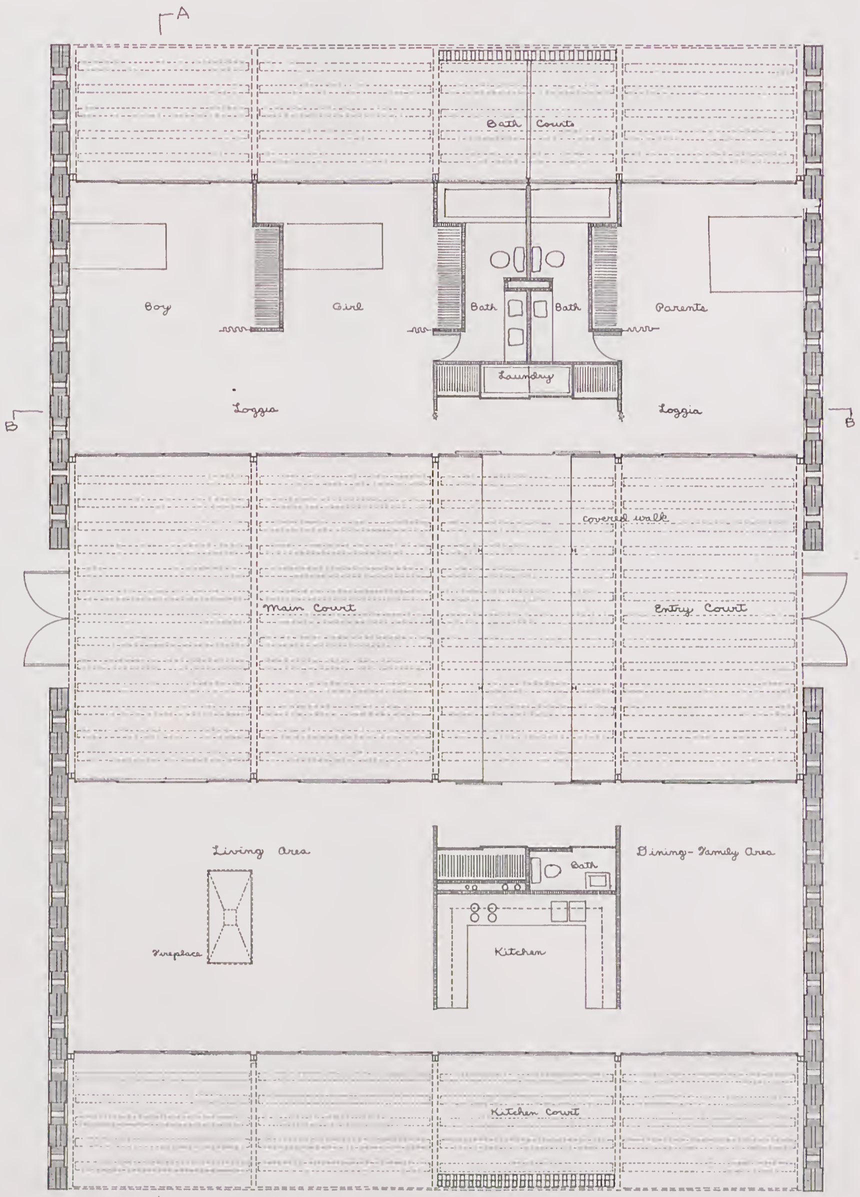
Plot Plan



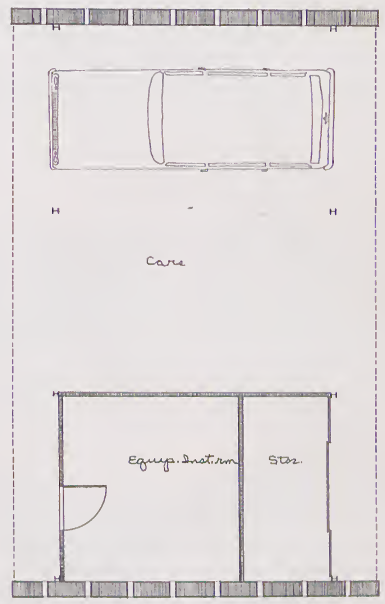
Cubage
A. 18X51X10 - 9180
B. 18X51X10 - 9180
C. 12X13.5X10 - 1620
Total 19,980



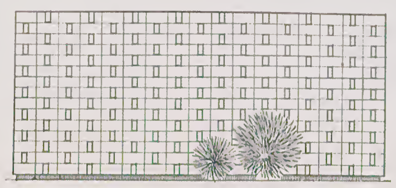
Plan – Swimming Enclosure



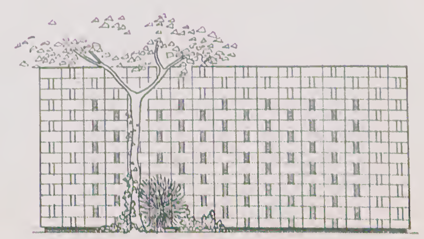
Plan – Residence



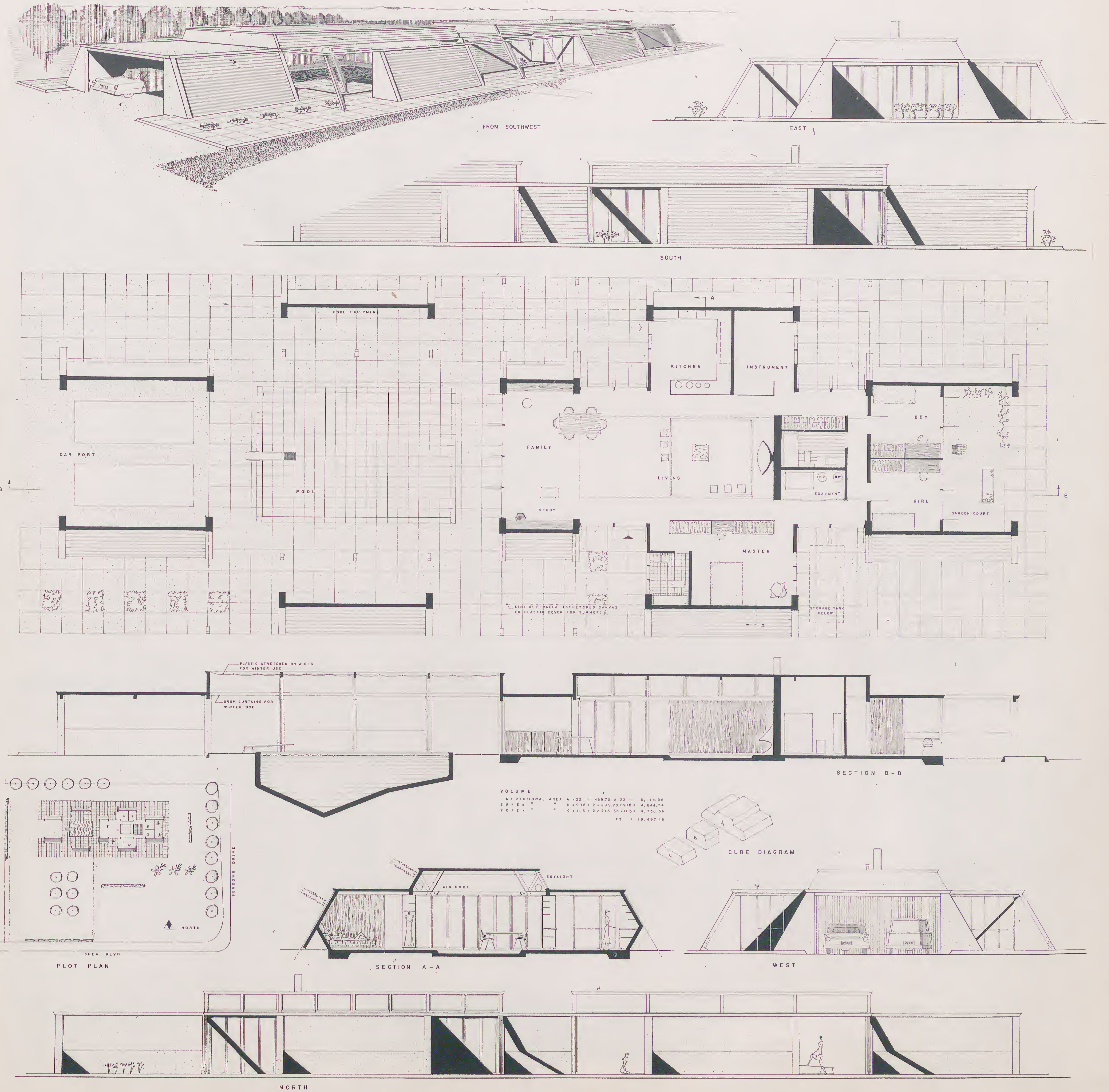
Plan – Carport – Equipment rm



South

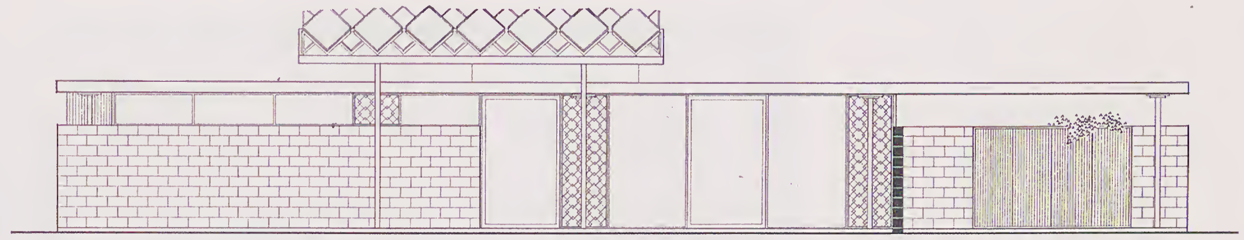


2 ANNA CAMPBELL BLISS, Minneapolis, Minn. **SECOND PRIZE**

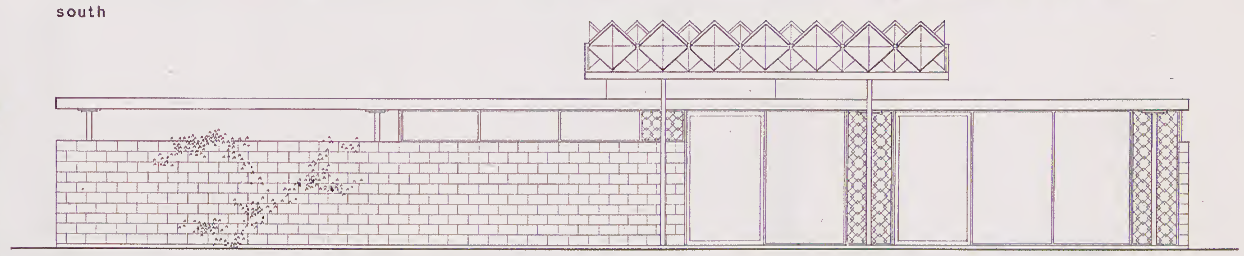


JOHN N. MORPHETT and HANFORD YANG, Cambridge, Mass.

plan

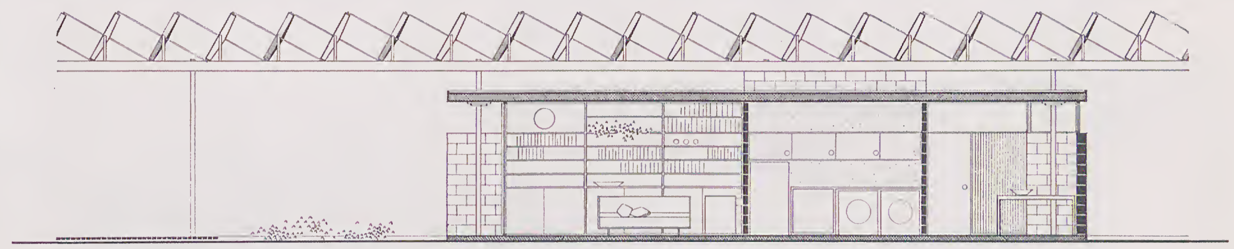


south

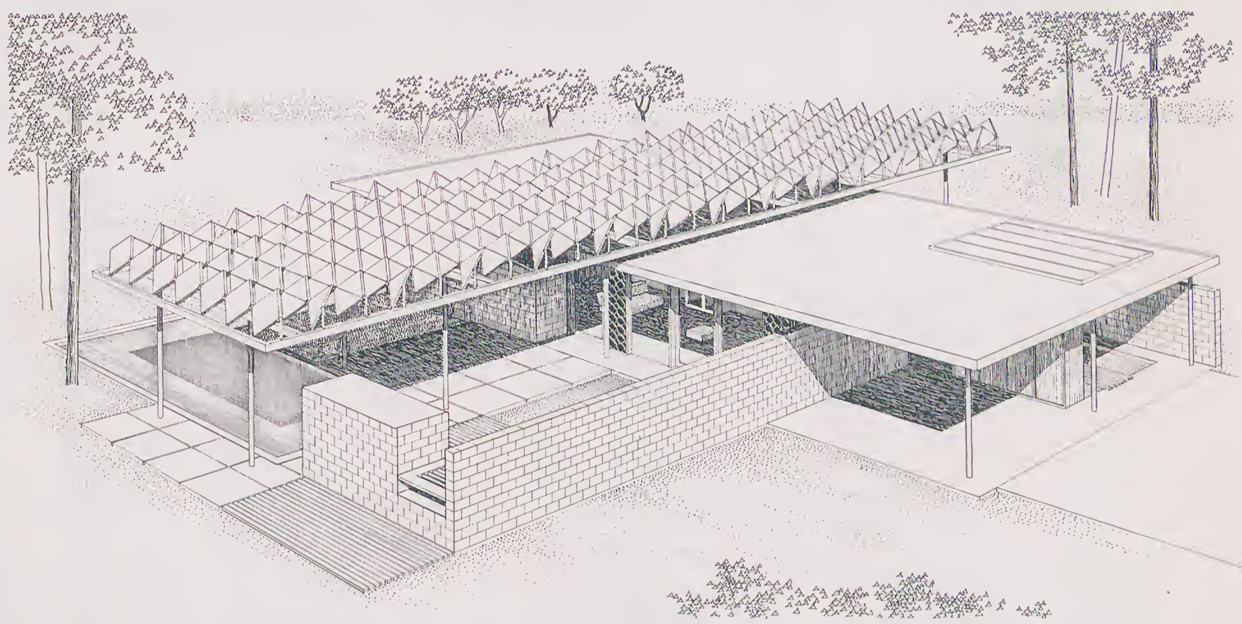


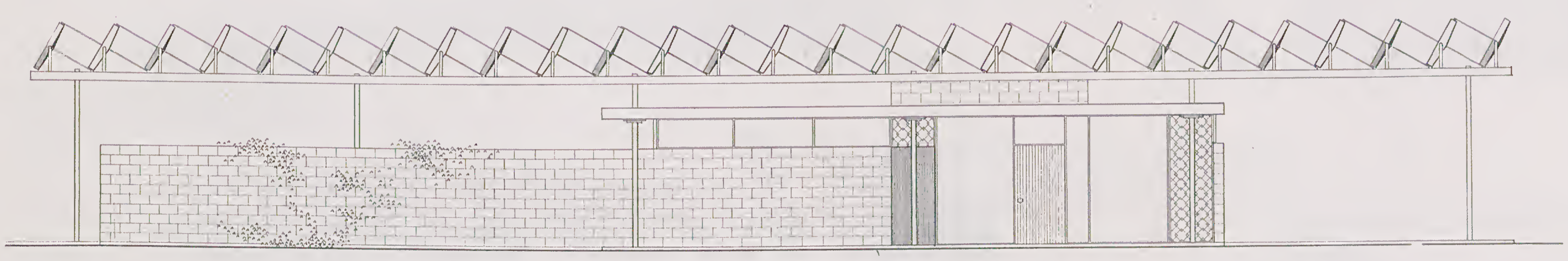
north

a-a

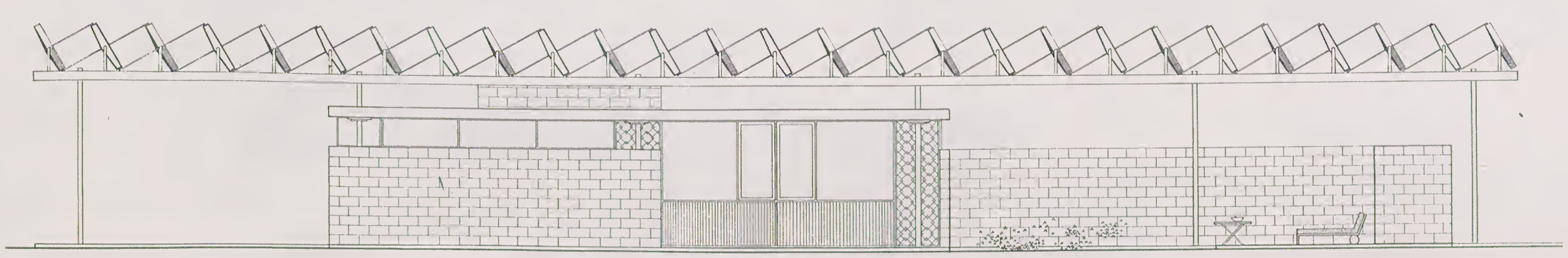


b-b

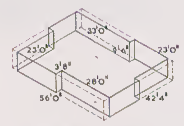




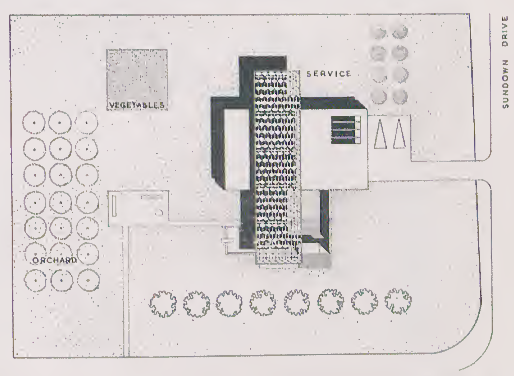
east



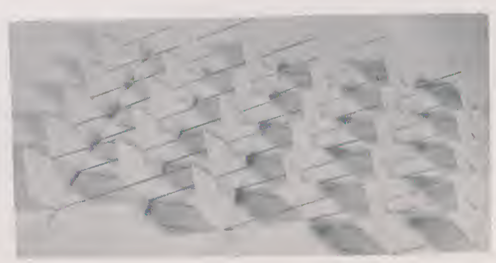
west



cubage diagram

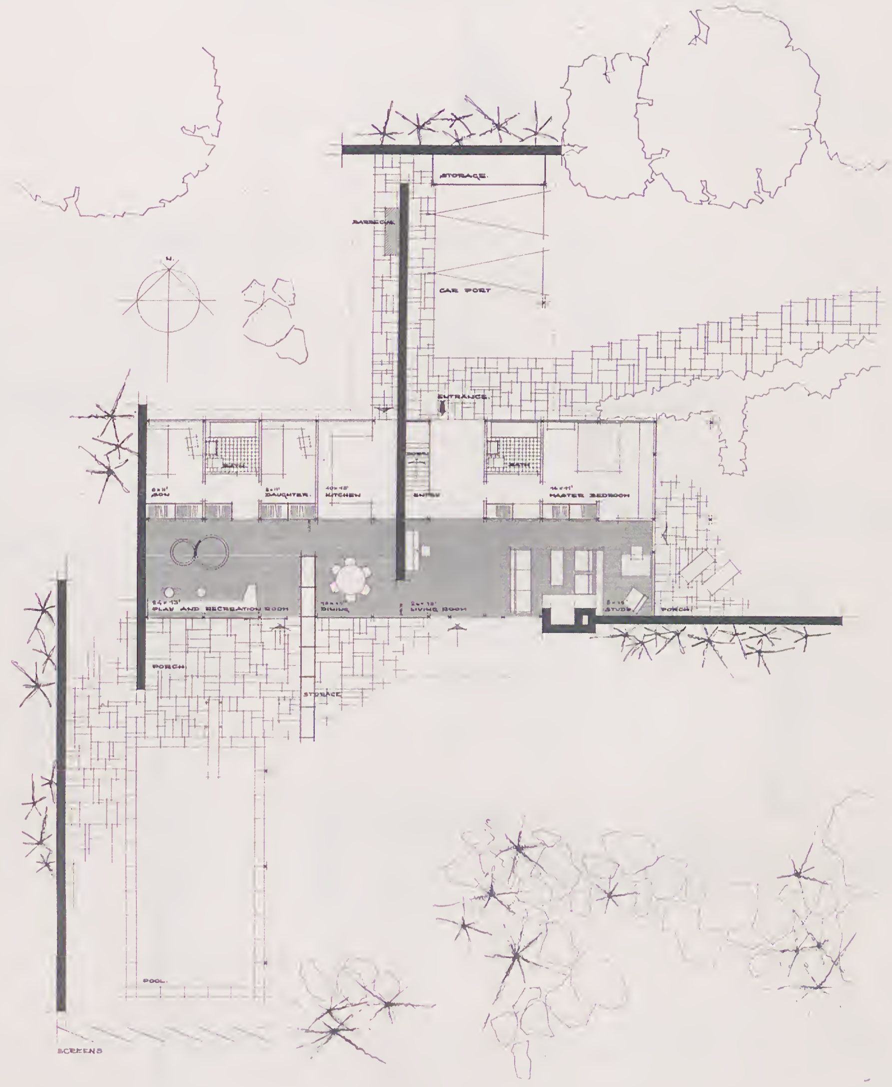


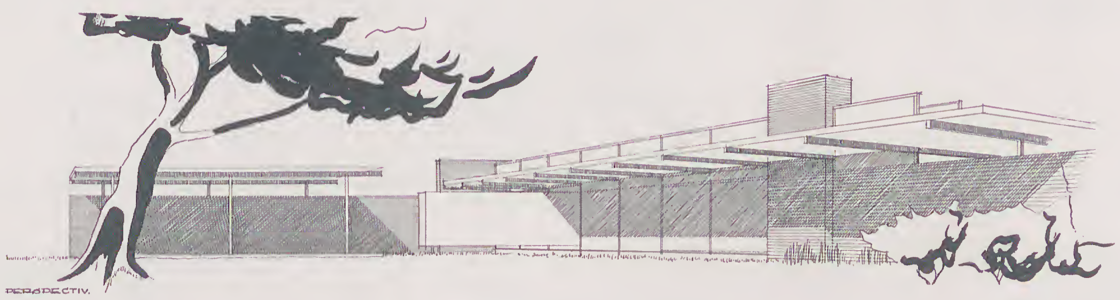
plot plan



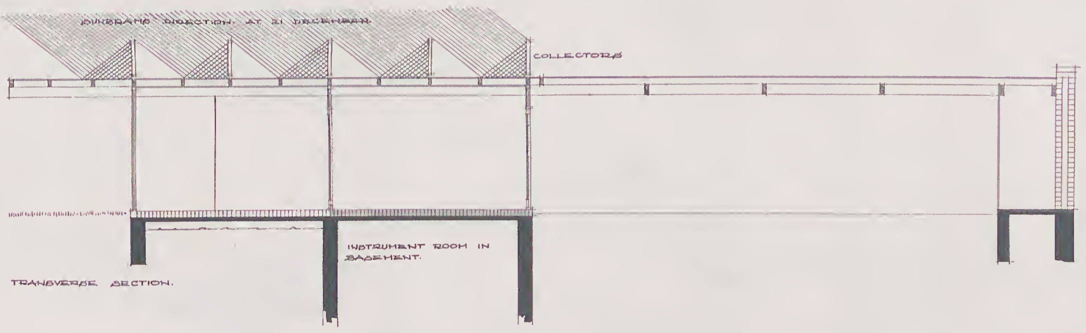
solar collector

4 I. C. CHRISTENSEN, Arhus, Denmark, and BENT WINDELOV, Skive, Denmark — FOURTH PRIZE



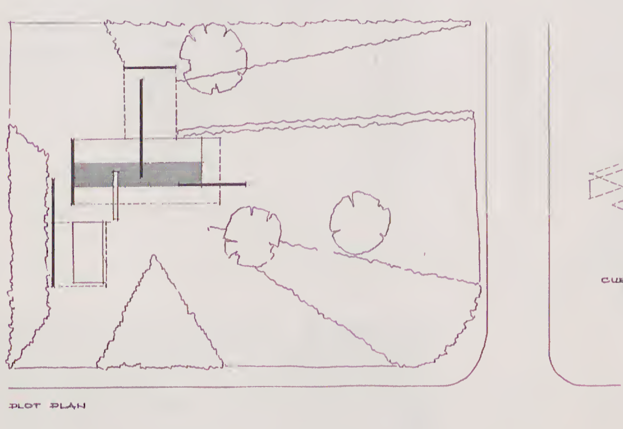


PERSPECTIV.

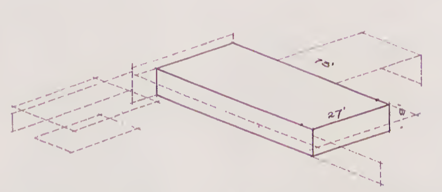


TRANSVERSE SECTION.

LONGITUDINAL SECTION.



PLOT PLAN

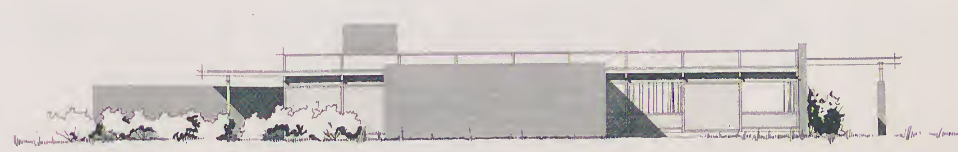


CUBAGE DIAGRAM. CUBIC CONTENT 17800 CUBICFEET.

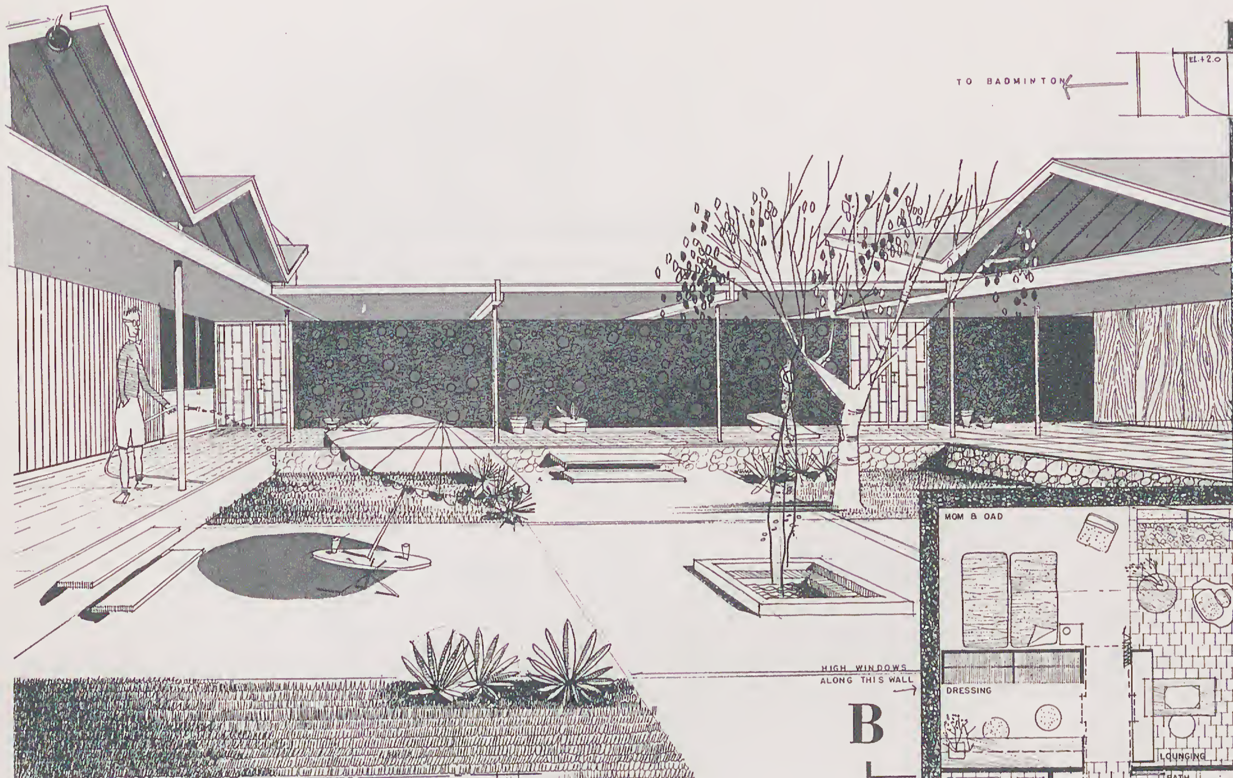
EAST ELEVATION.

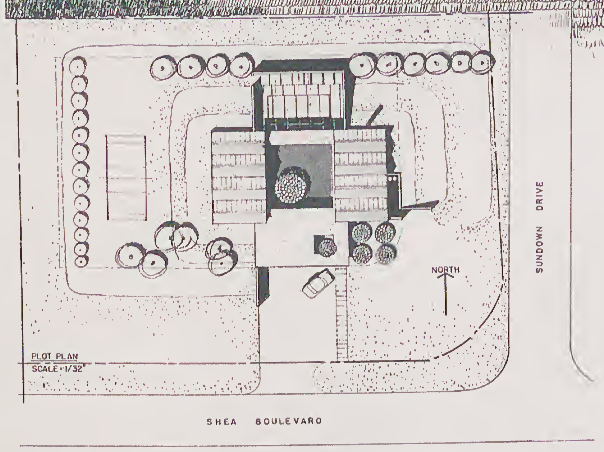
SOUTH ELEVATION.

WEST ELEVATION.

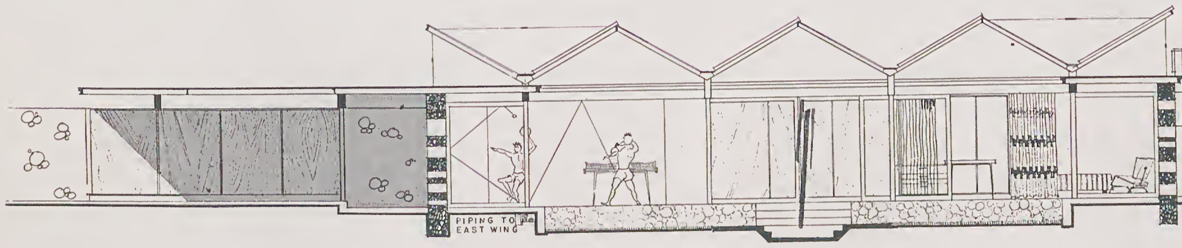


NORTH ELEVATION.

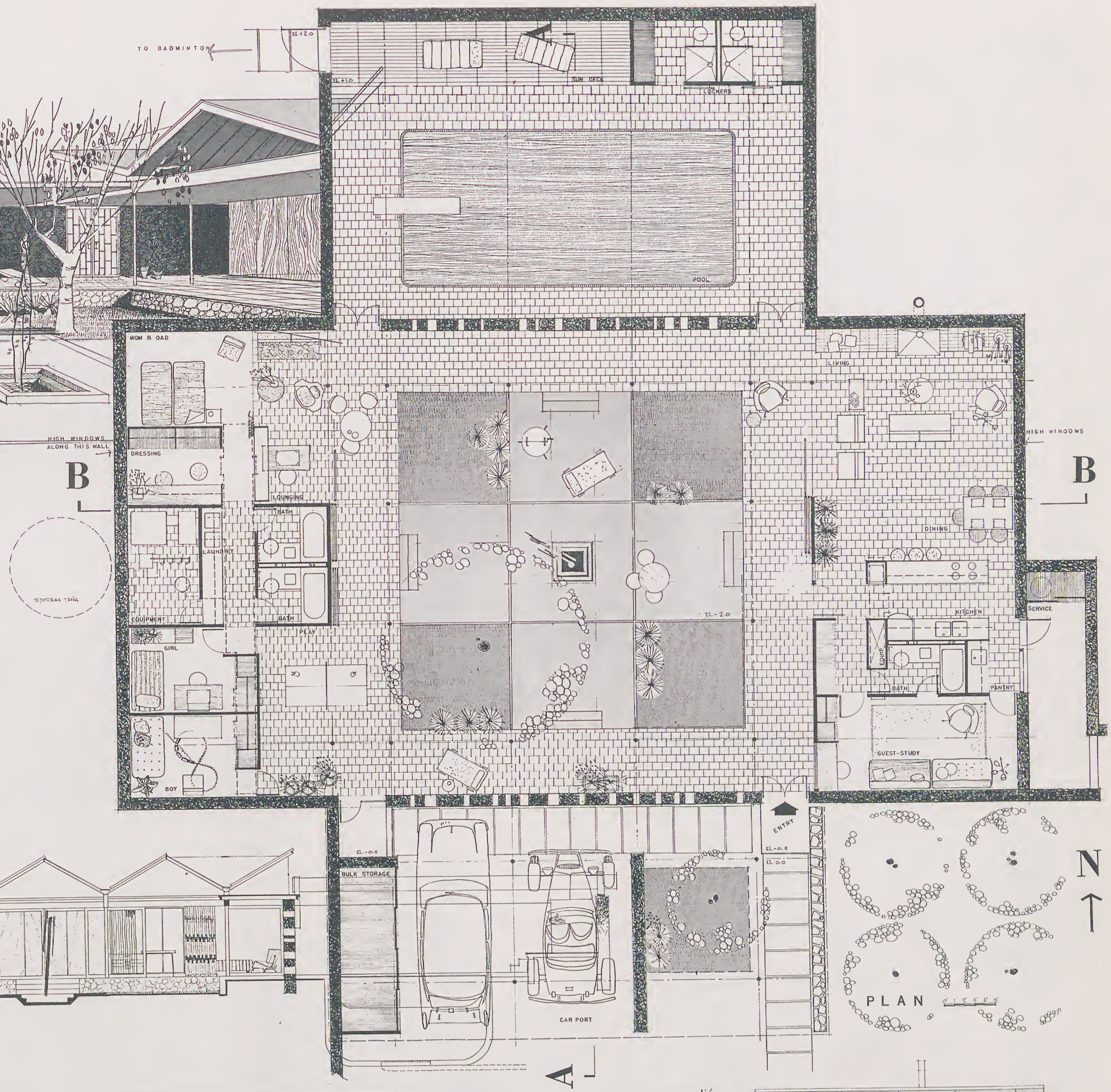


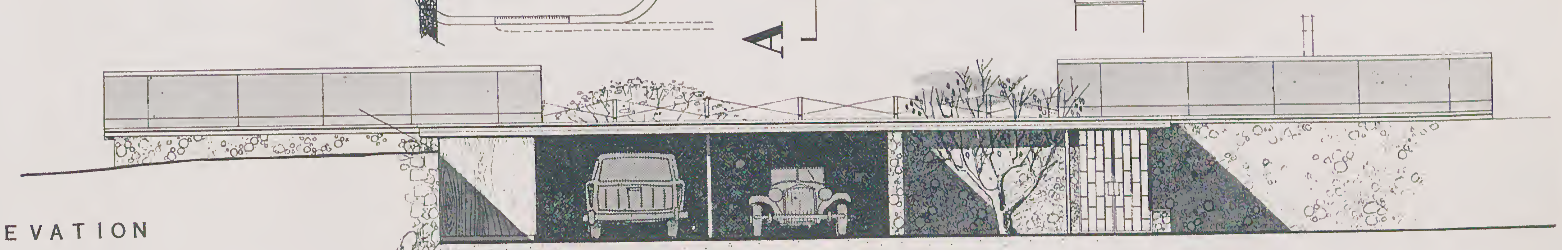


PLOT PLAN

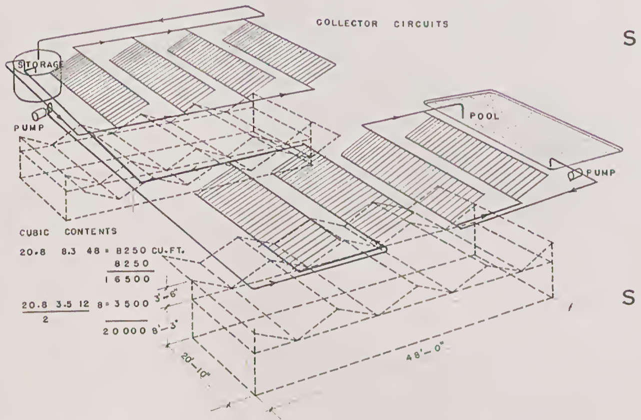


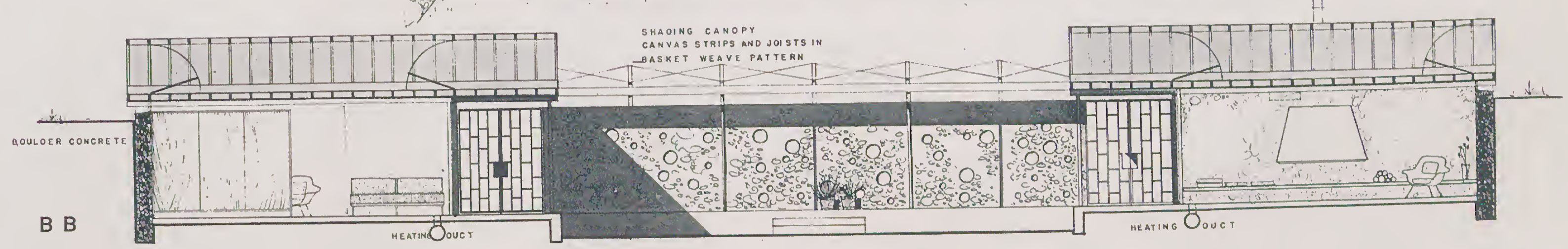
SECTION AA



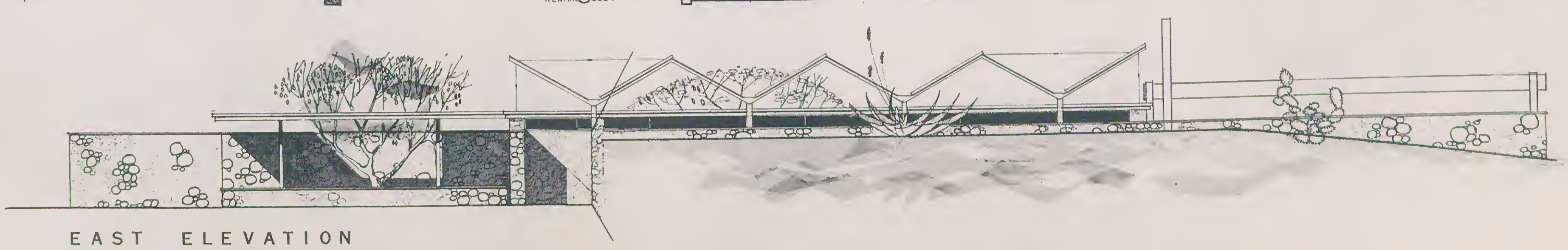


SOUTH ELEVATION



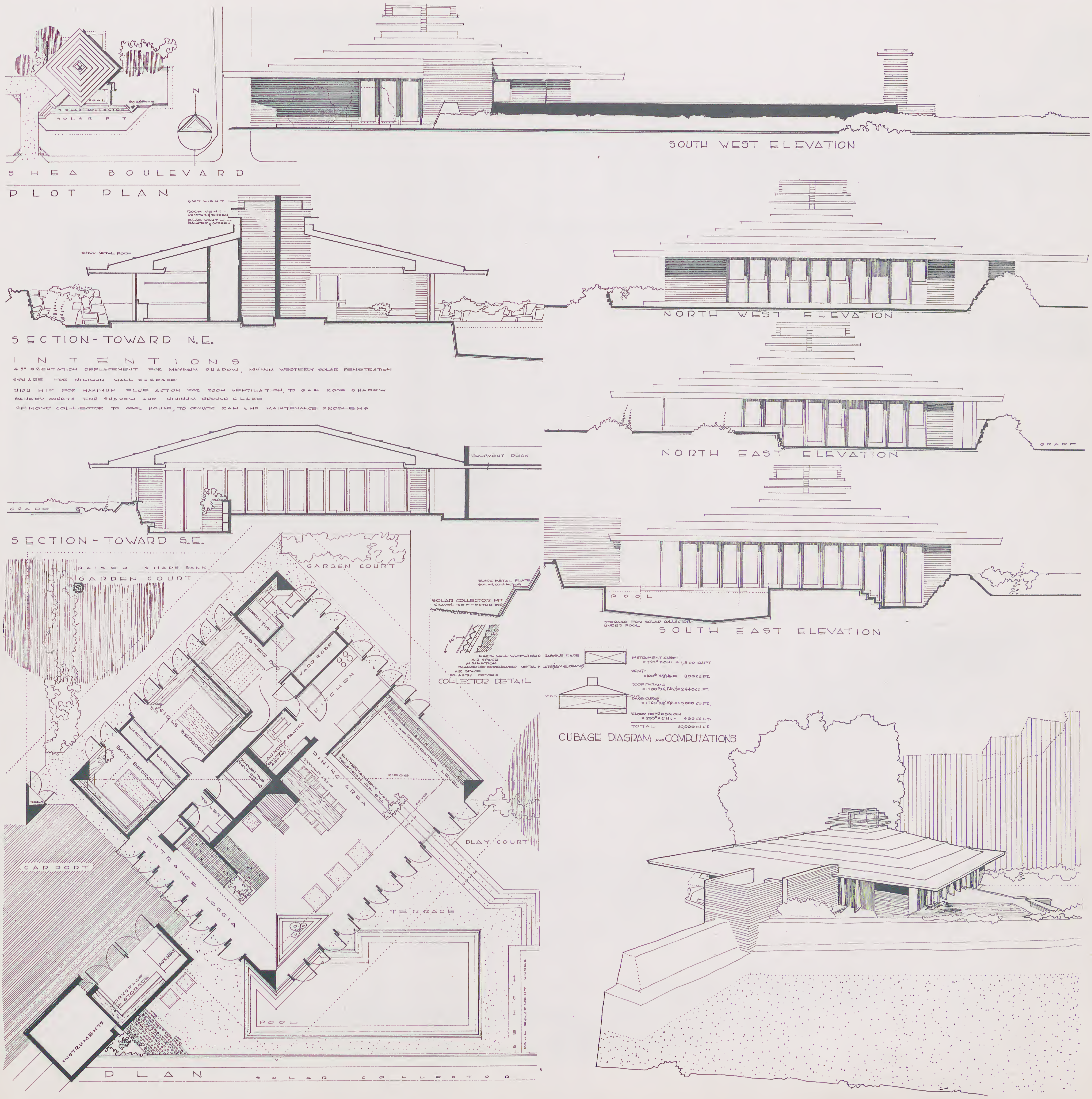


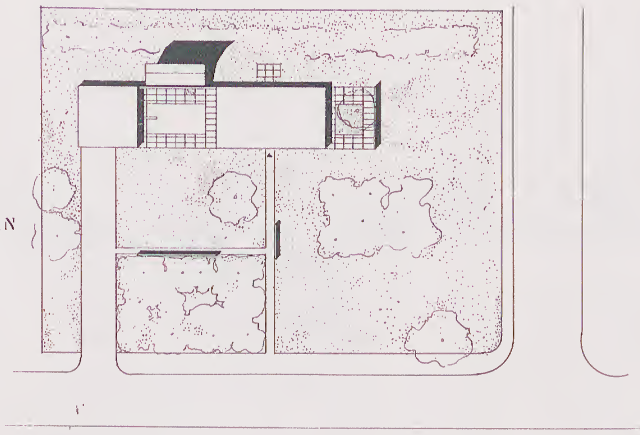
SECTION BB



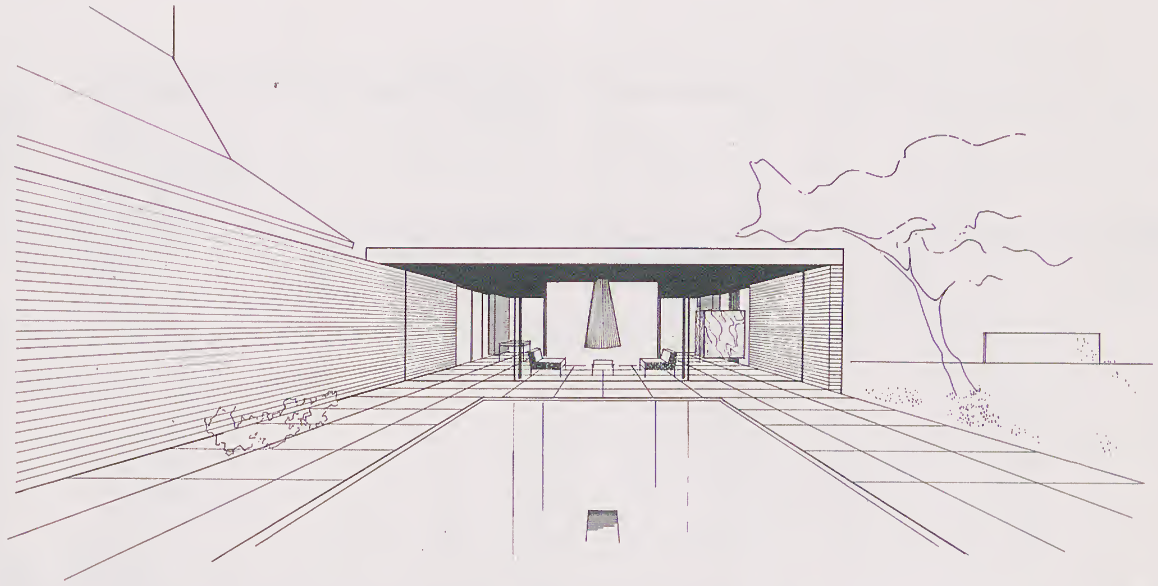
EAST ELEVATION

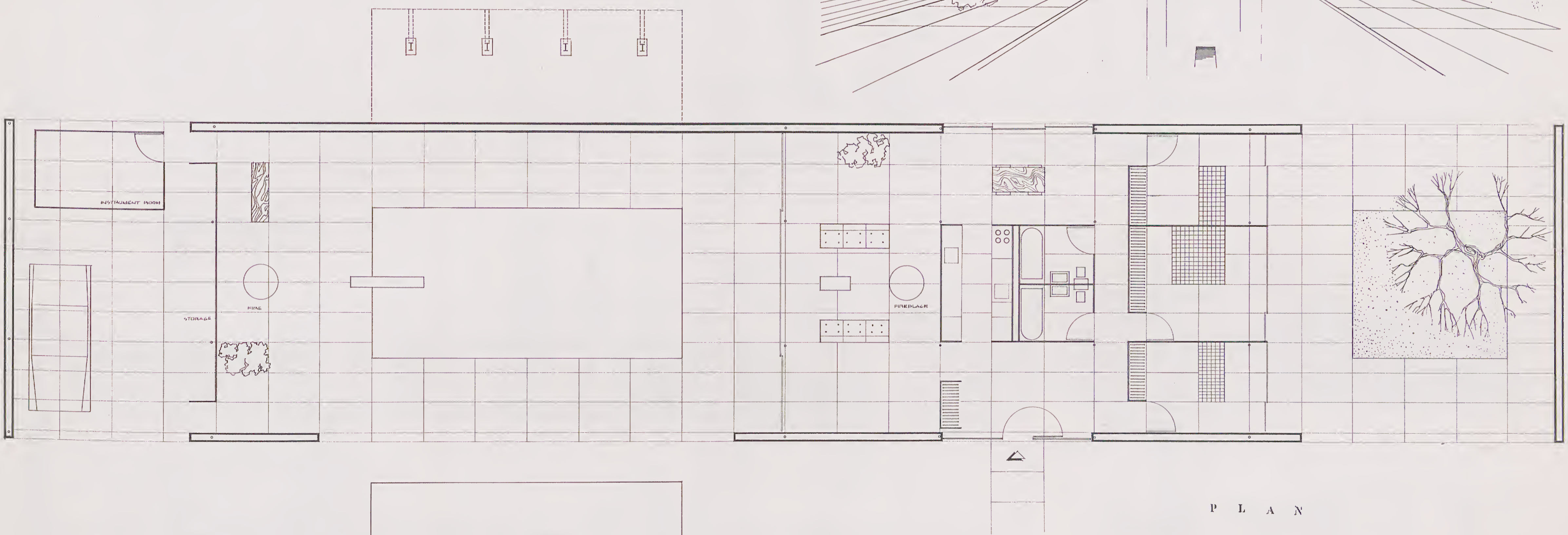
HONORABLE MENTION



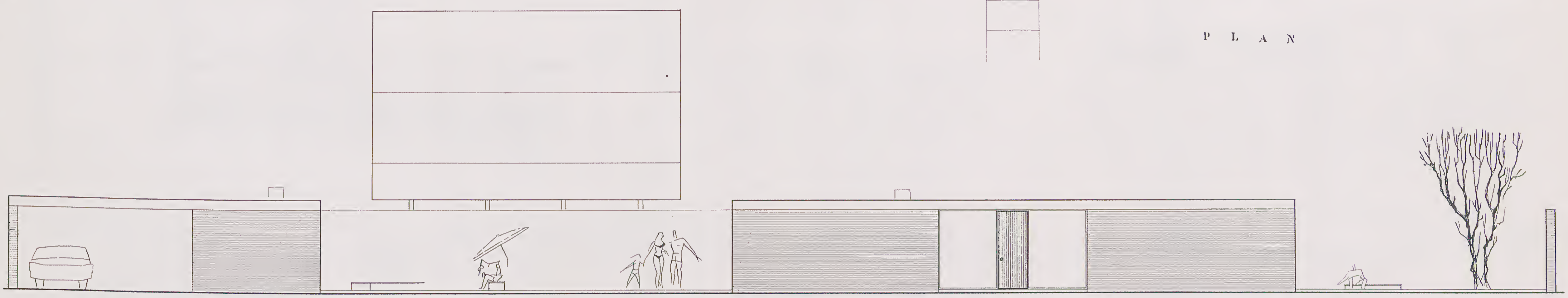


PLOT PLAN

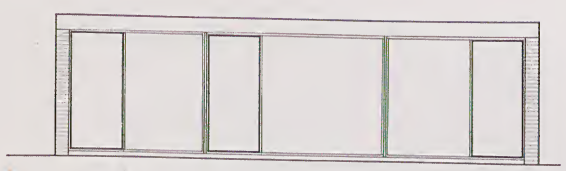




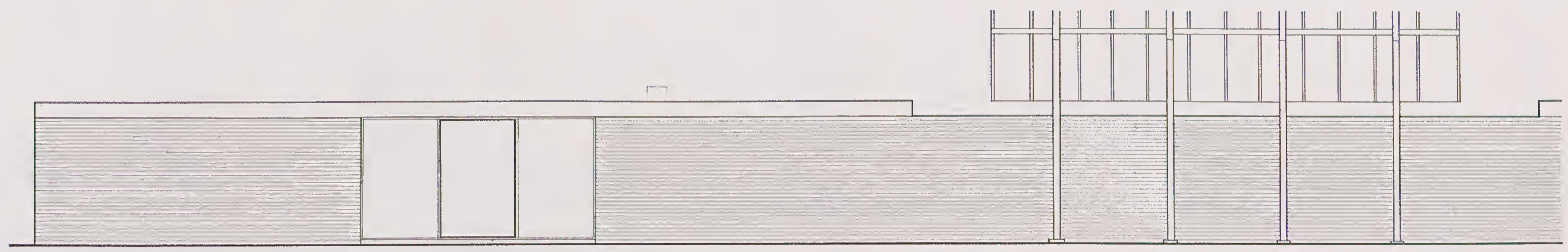
PLAN



SOUTH



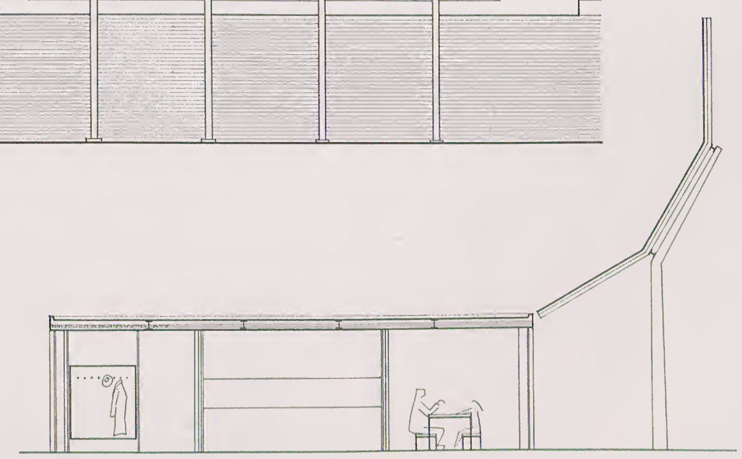
EAST



NORTH

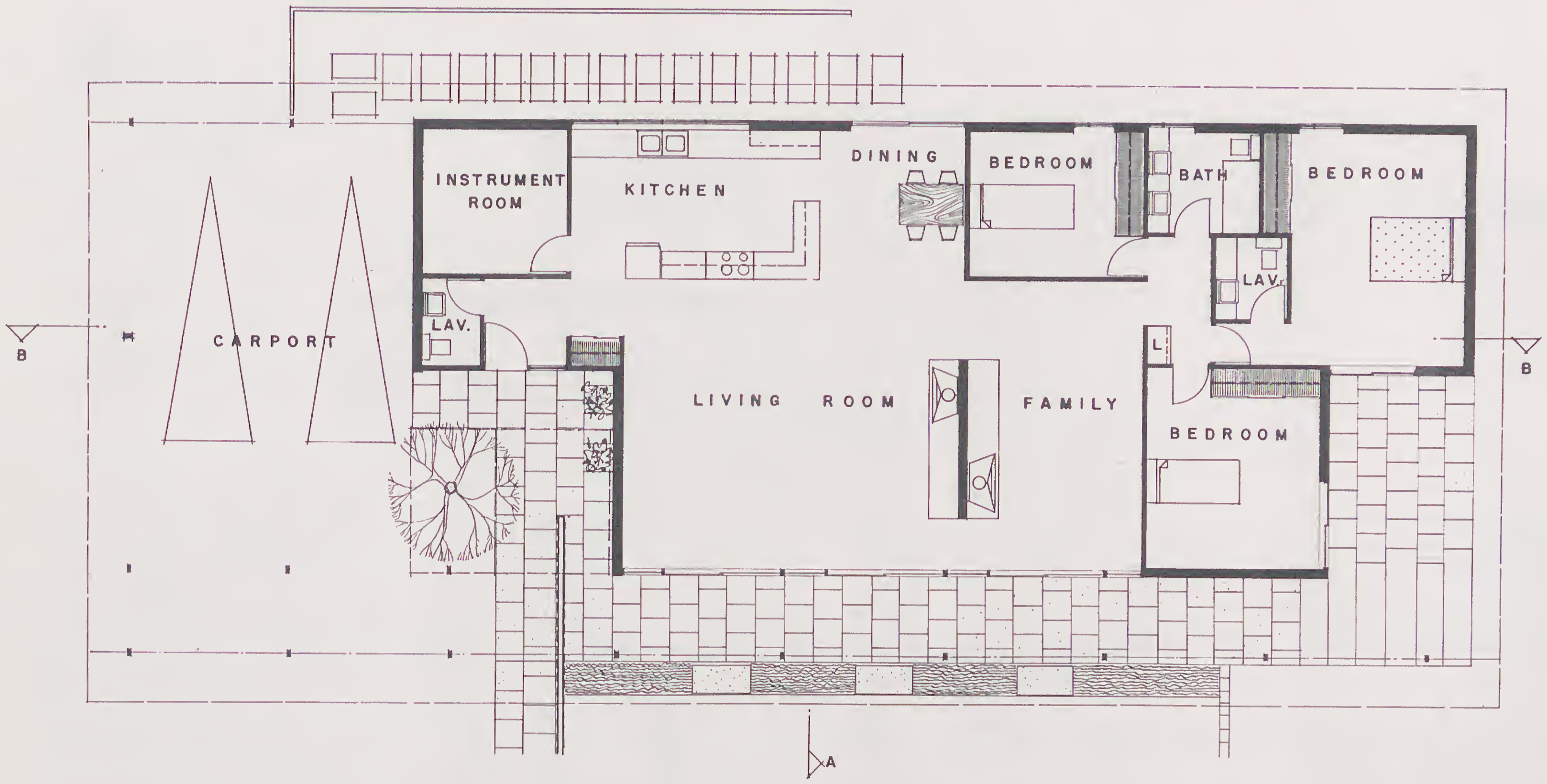
WEST

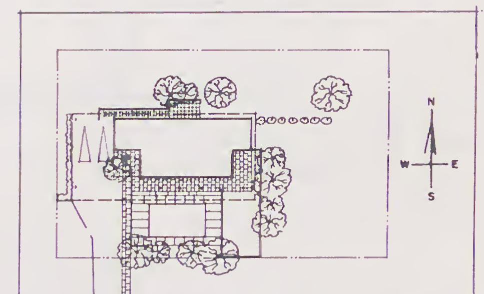
LONGITUDINAL



TRANSVERSE

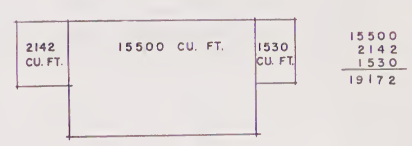
HONORABLE MENTION

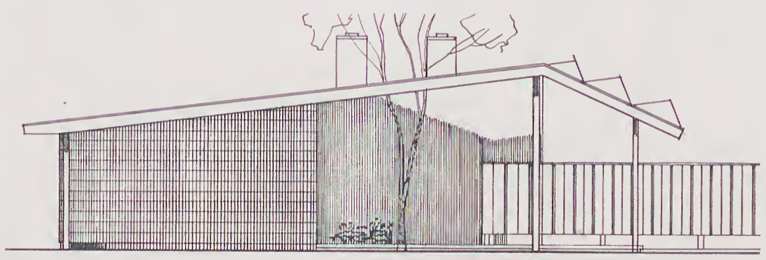


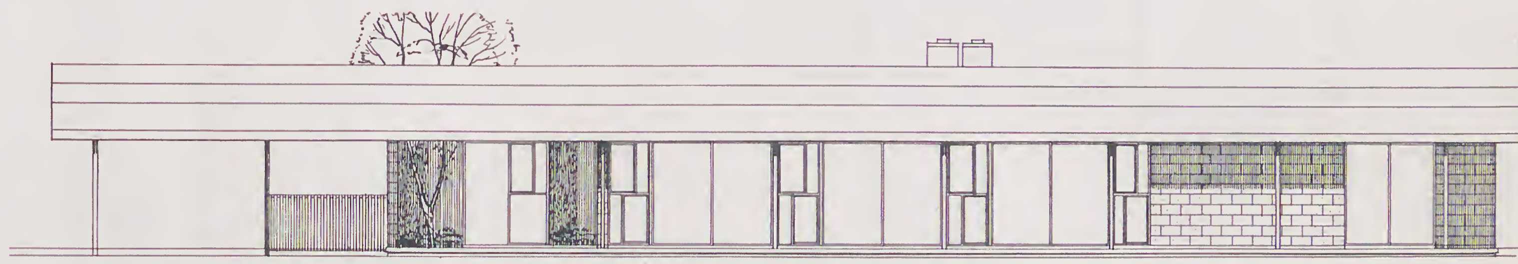


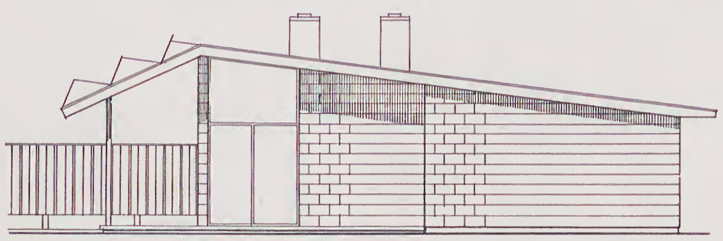
PLOT PLAN

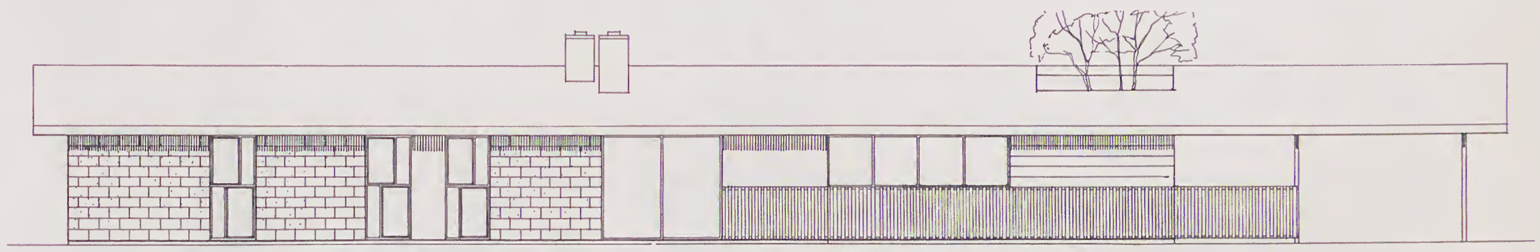
CUBAGE DIAGRAM

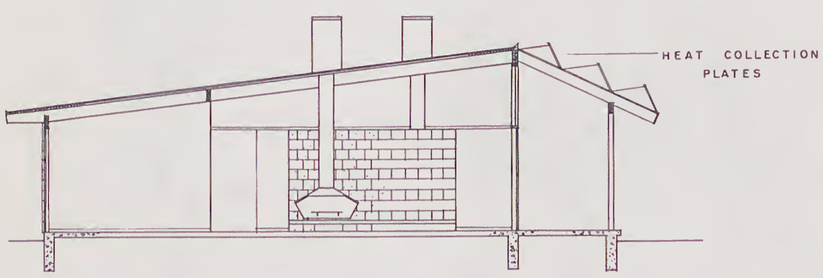



WEST ELEVATION

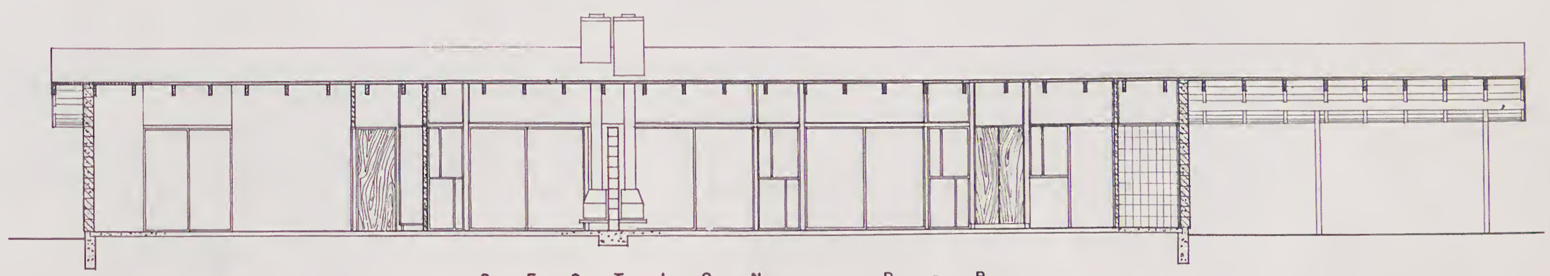

SOUTH ELEVATION

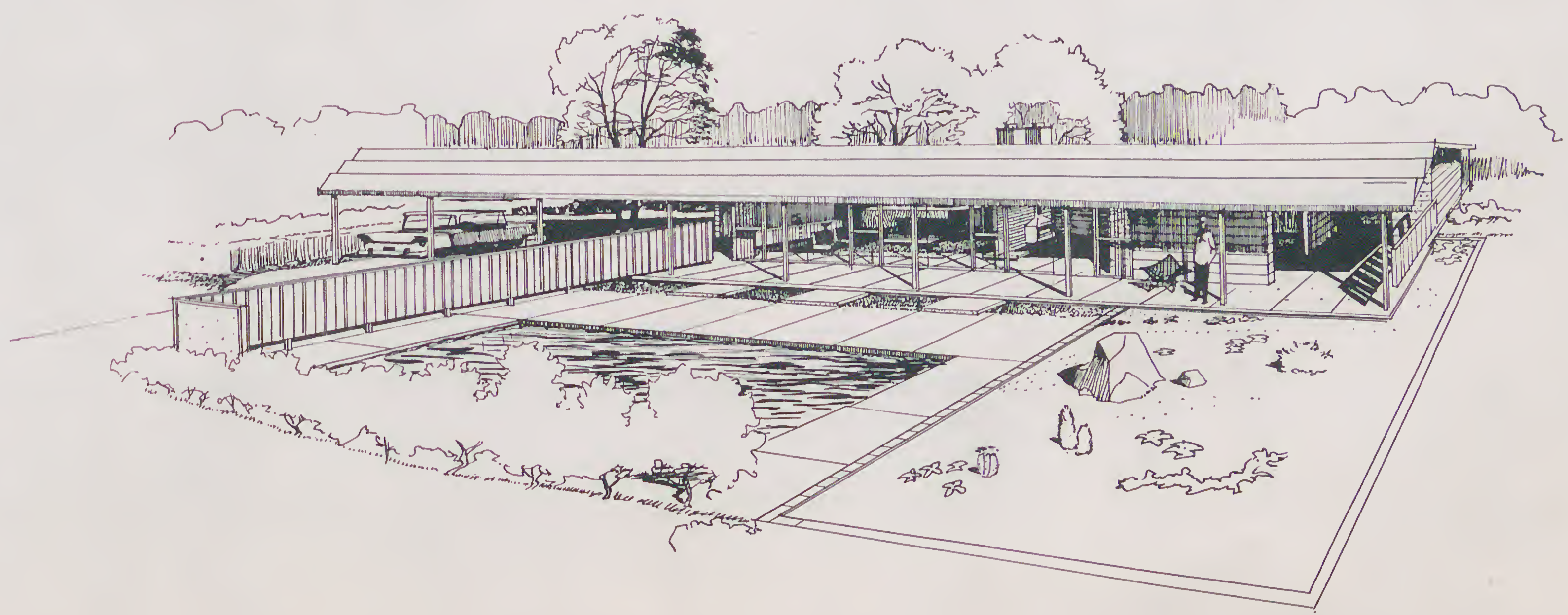

EAST ELEVATION

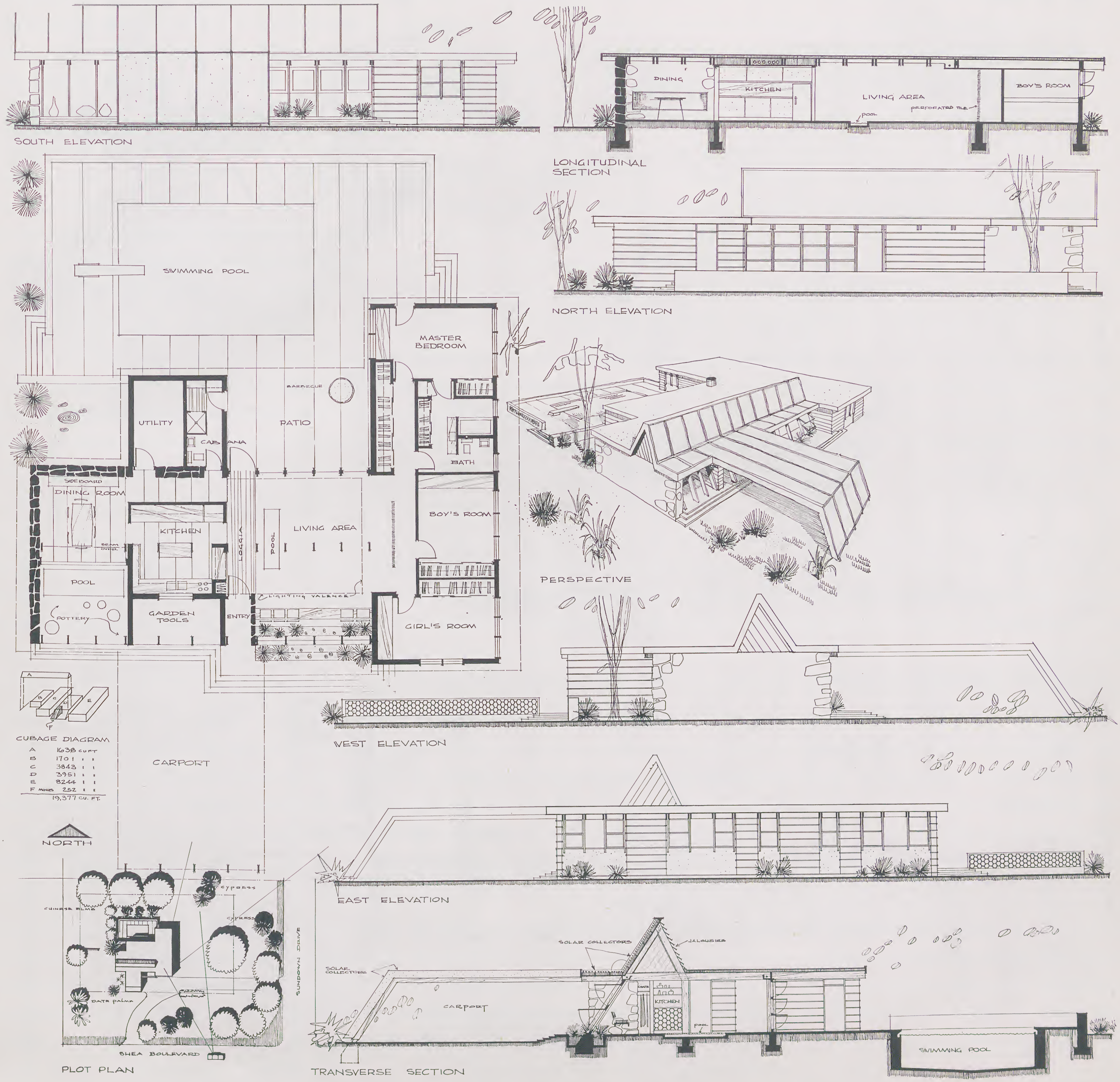

NORTH ELEVATION



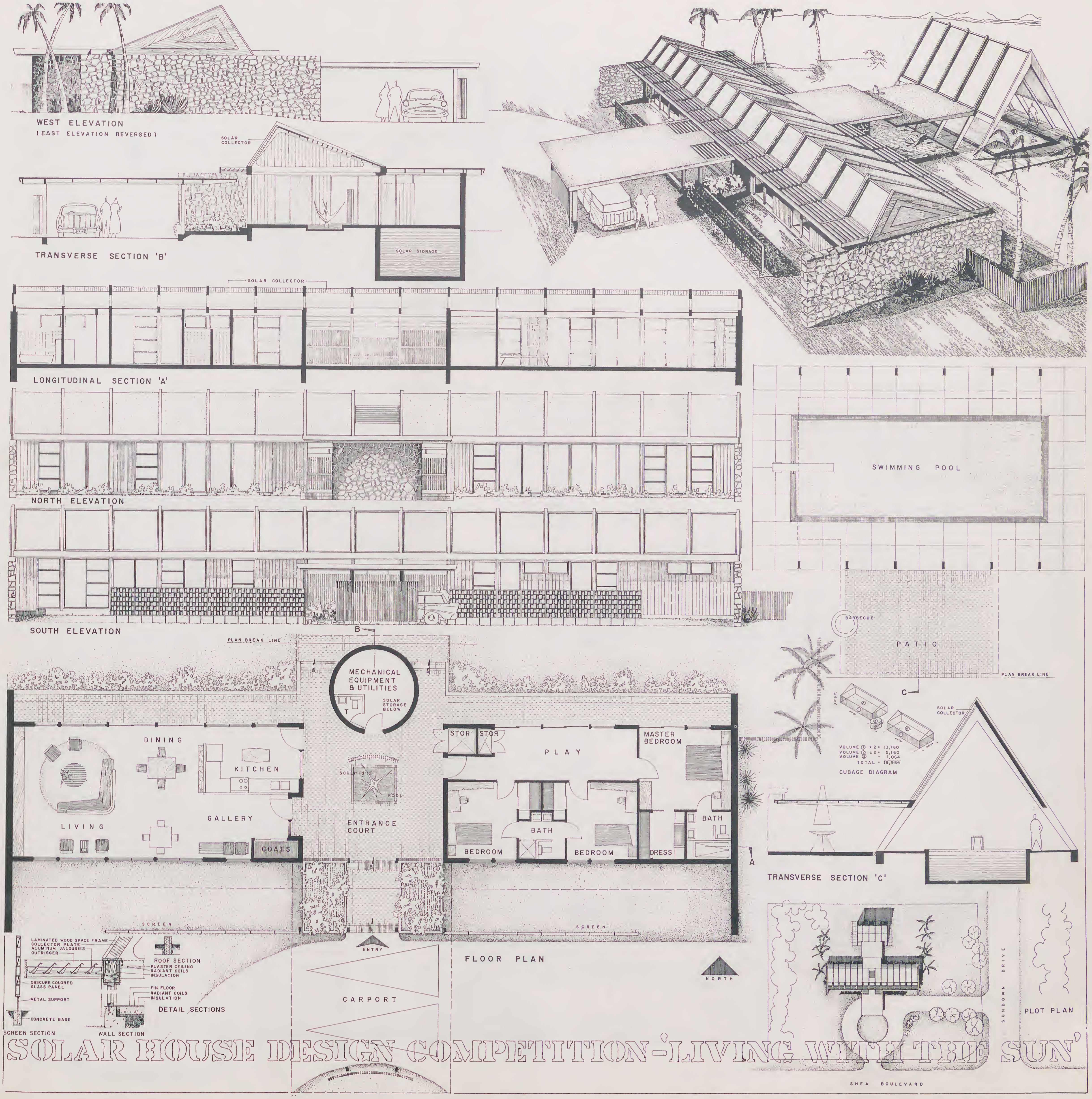
SECTION A-A

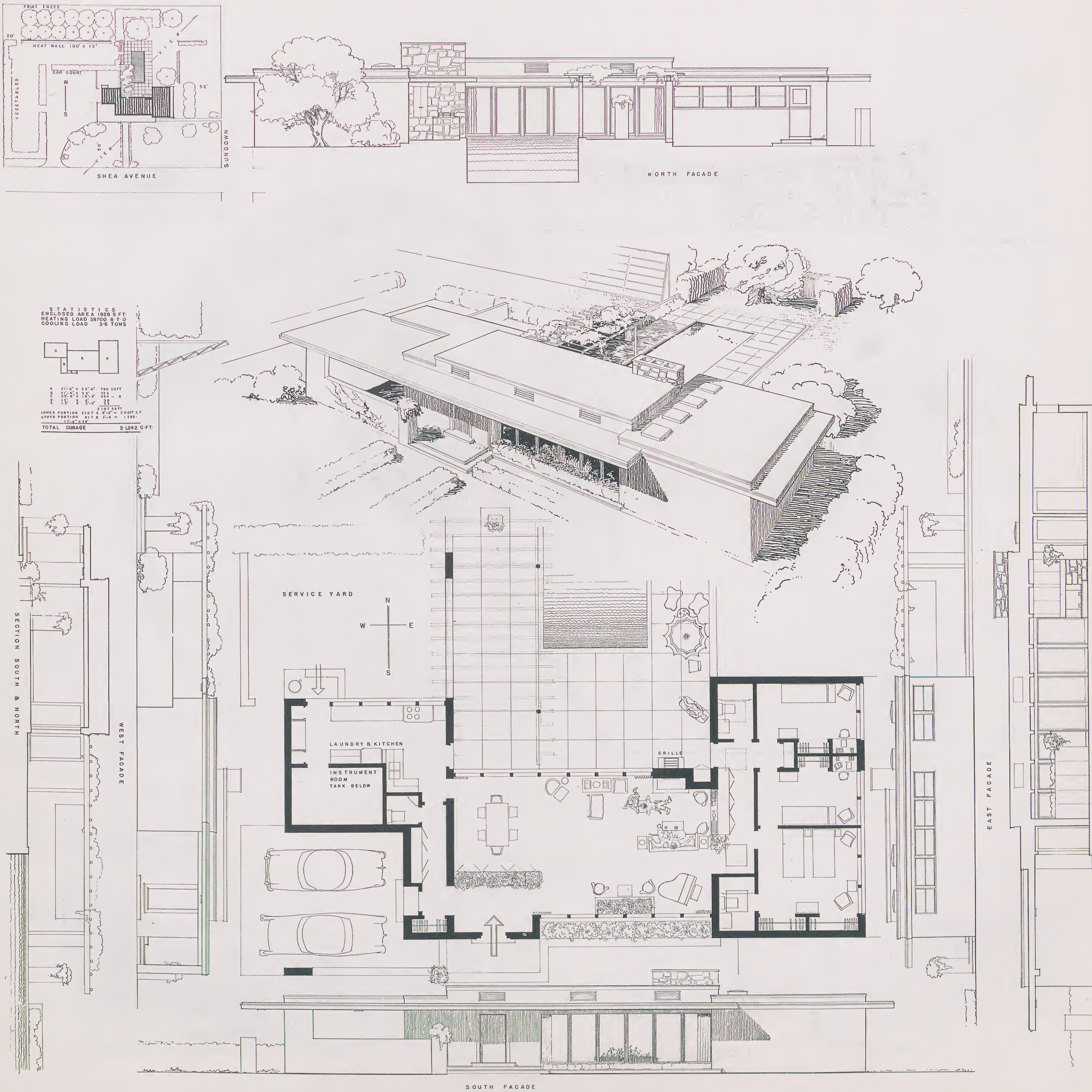

SECTION B-B



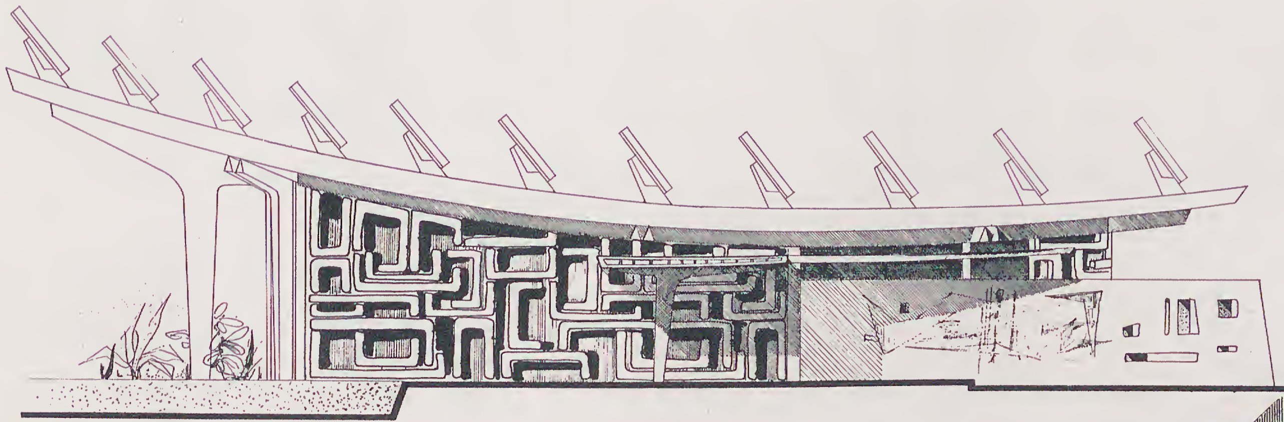

SOUTH ELEVATION
DINING
KITCHEN
LIVING AREA
BOY'S ROOM
POOL
PERFORATED TILE
LONGITUDINAL SECTION
NORTH ELEVATION
SWIMMING POOL
MASTER BEDROOM
BARBECUE
UTILITY
CABANA
PATIO
BATH
SIDEBOARD
DINING ROOM
KITCHEN
LOGGIA
POOL
LIVING AREA
BOY'S ROOM
POOL
POTTERY
GARDEN TOOLS
ENTRY
LIGHTING VALENCE
GIRL'S ROOM
PERSPECTIVE
WEST ELEVATION
CUBAGE DIAGRAM
A 1638 CU. FT.
B 1701
C 3843
D 3951
E 8244
F MINUS 252
19,377 CU. FT.
CARPORT
NORTH
EAST ELEVATION
CYPRESS
CHINESE ELMS
CYPRESS
DATE PALMS
SUNDOWN DRIVE
SHEA BOULEVARD
PLOT PLAN
SOLAR COLLECTORS
JALOUSIES
SOLAR COLLECTORS
CARPORT
KITCHEN
SWIMMING POOL
TRANSVERSE SECTION

10 JESUS M. ARTIAGA and RODNEY E. NEUJAHR, Des Moines, Iowa

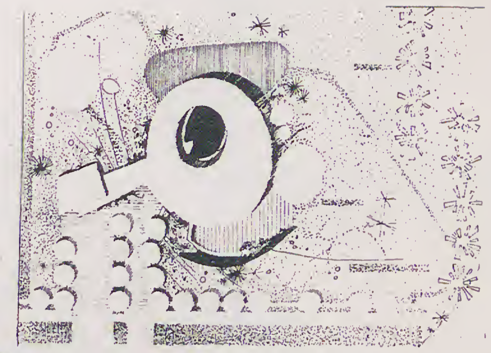



FRUIT TREES
HEAT WALL 100' X 12'
CAR COURT
VEGETABLES
N
S
52'
SHEA AVENUE
SUNDOWN
NORTH FACADE
STATISTICS
ENCLOSED AREA 1828 S·FT·
HEATING LOAD 38700 B·T·U·
COOLING LOAD 3·6 TONS
A 21'-6" X 36'-6" 785 SQFT
B 21'-6" X 36' 774
C 23'-6" X 18'-6" 434 – 9
D 15' X 6' 90
E 13' X 2'-6" 33
2107 SQFT
LOWER PORTION 2107 X 9'-6" = 20017 CF
UPPER PORTION 817 X 1'-6 = 1225
21'-6" X 38'
TOTAL CUBAGE 21,242 C·FT·
SERVICE YARD
N
W
E
S
LAUNDRY & KITCHEN
INSTRUMENT ROOM TANK BELOW
GRILLE
SECTION SOUTH & NORTH
WEST FACADE
EAST FACADE
SECTION WEST & EAST
SOUTH FACADE

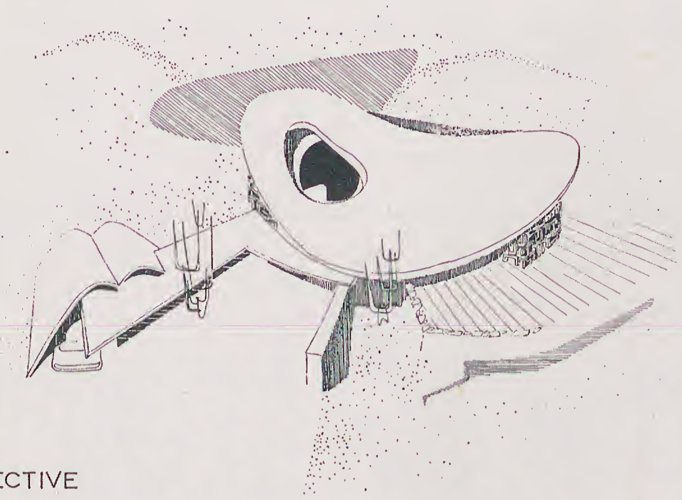
I. and G. BENOIT and FRANCOIS MAYER, Paris, France



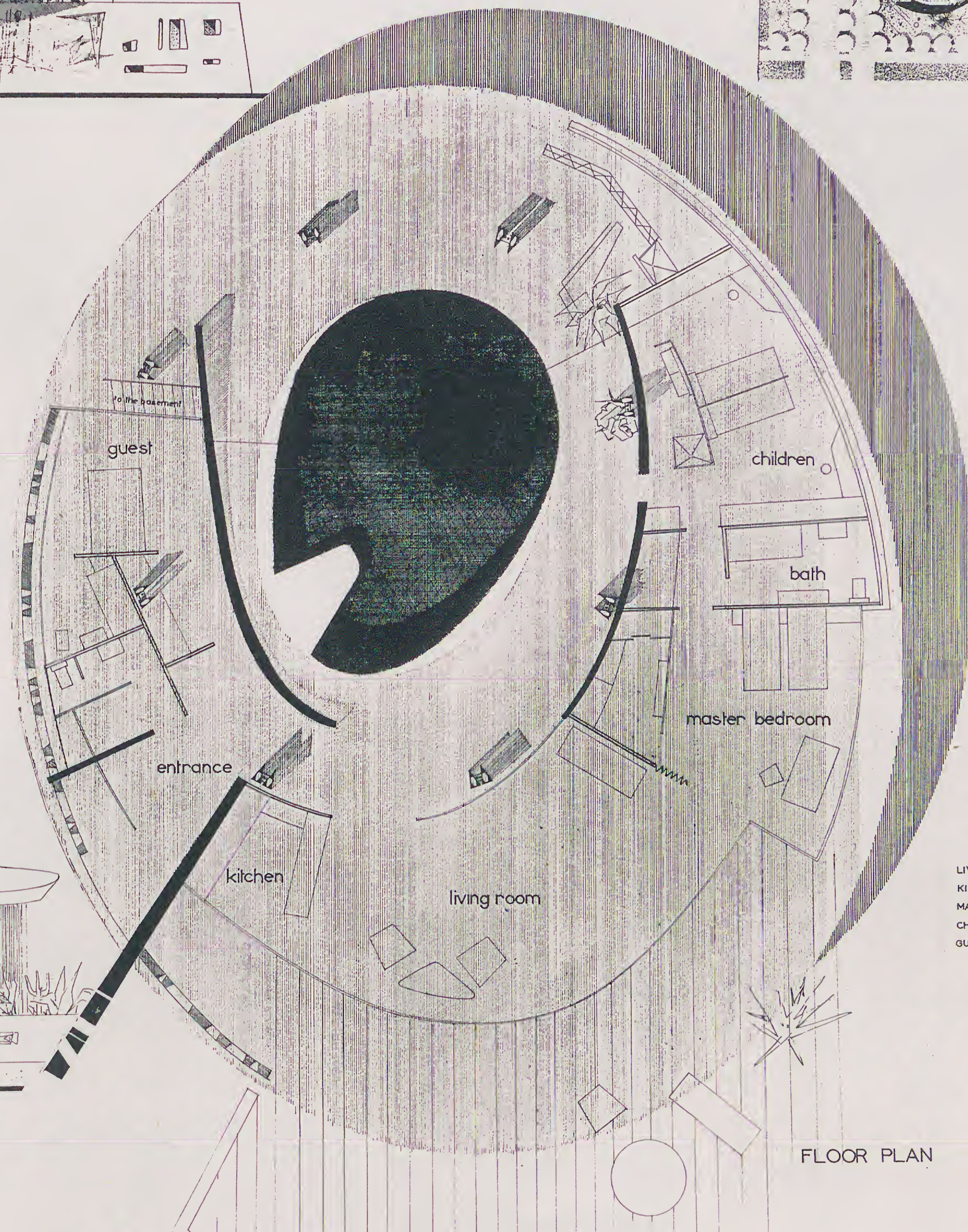
WEST ELEVATION



PLOT PLAN



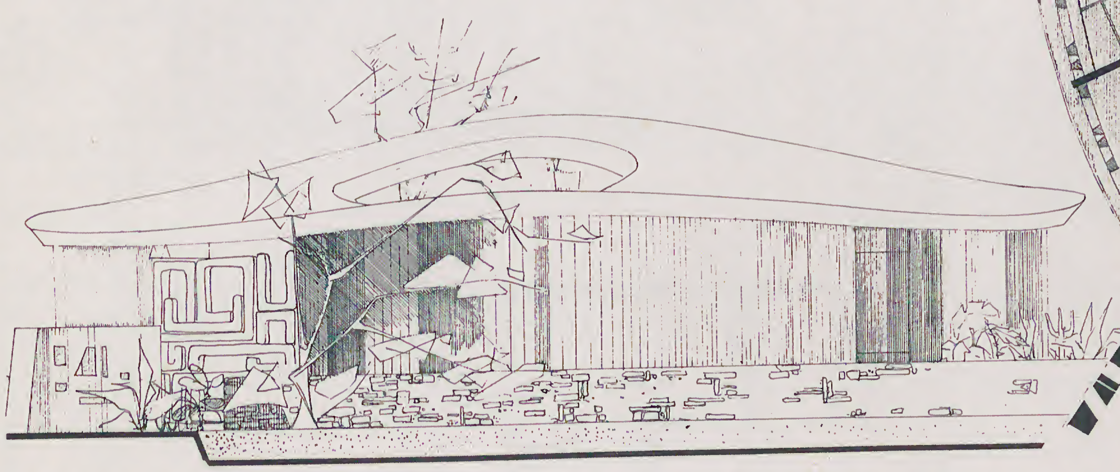
PERSPECTIVE



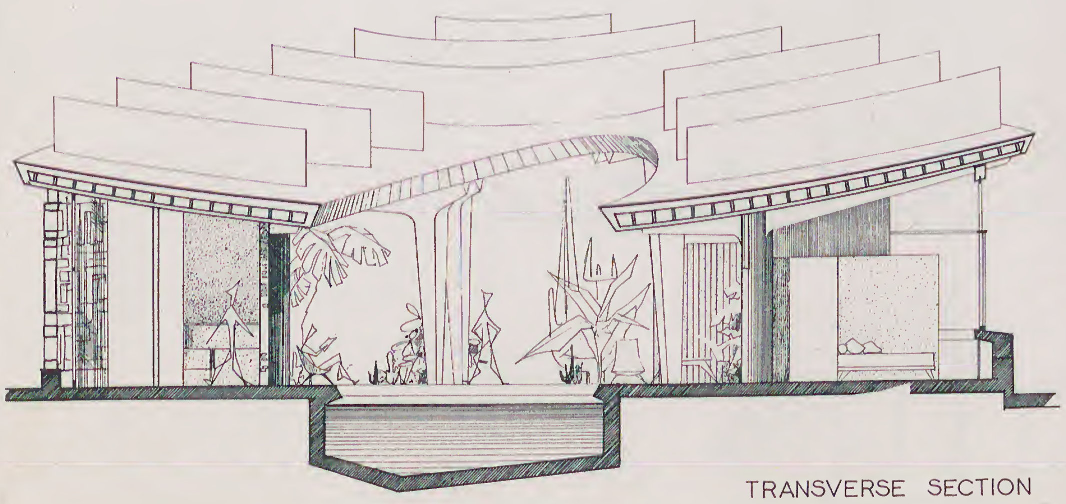
FLOOR PLAN

cubic contents

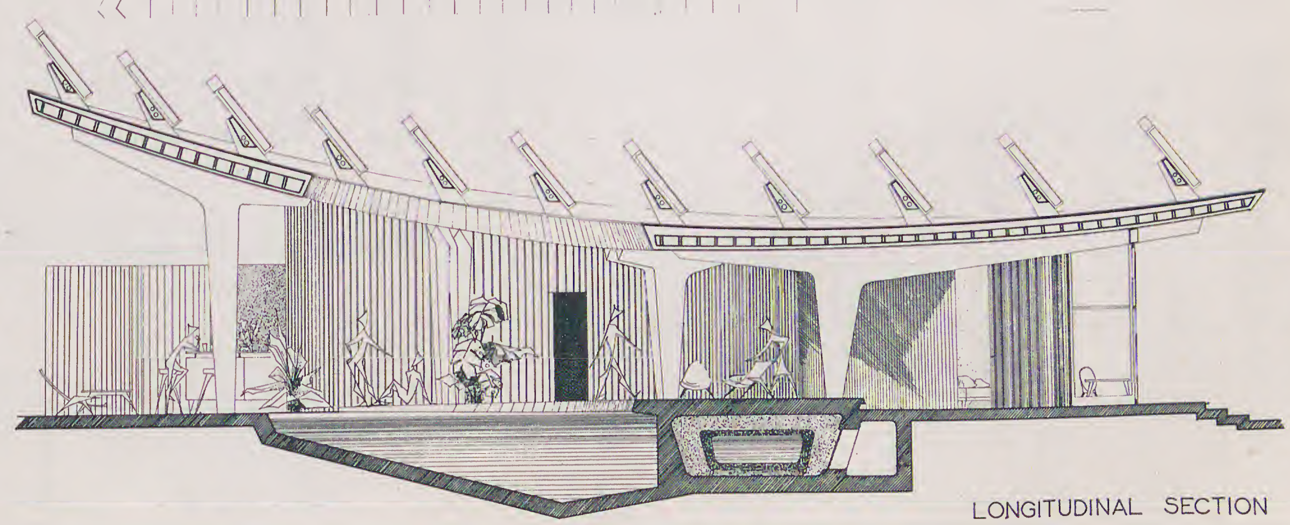
LIVING ROOM	5,350 C.F.
KITCHEN	1,000 C.F.
MASTER BEDROOM	2,300 C.F.
CHILDREN	1,280 C.F.
GUEST	1,530 C.F.



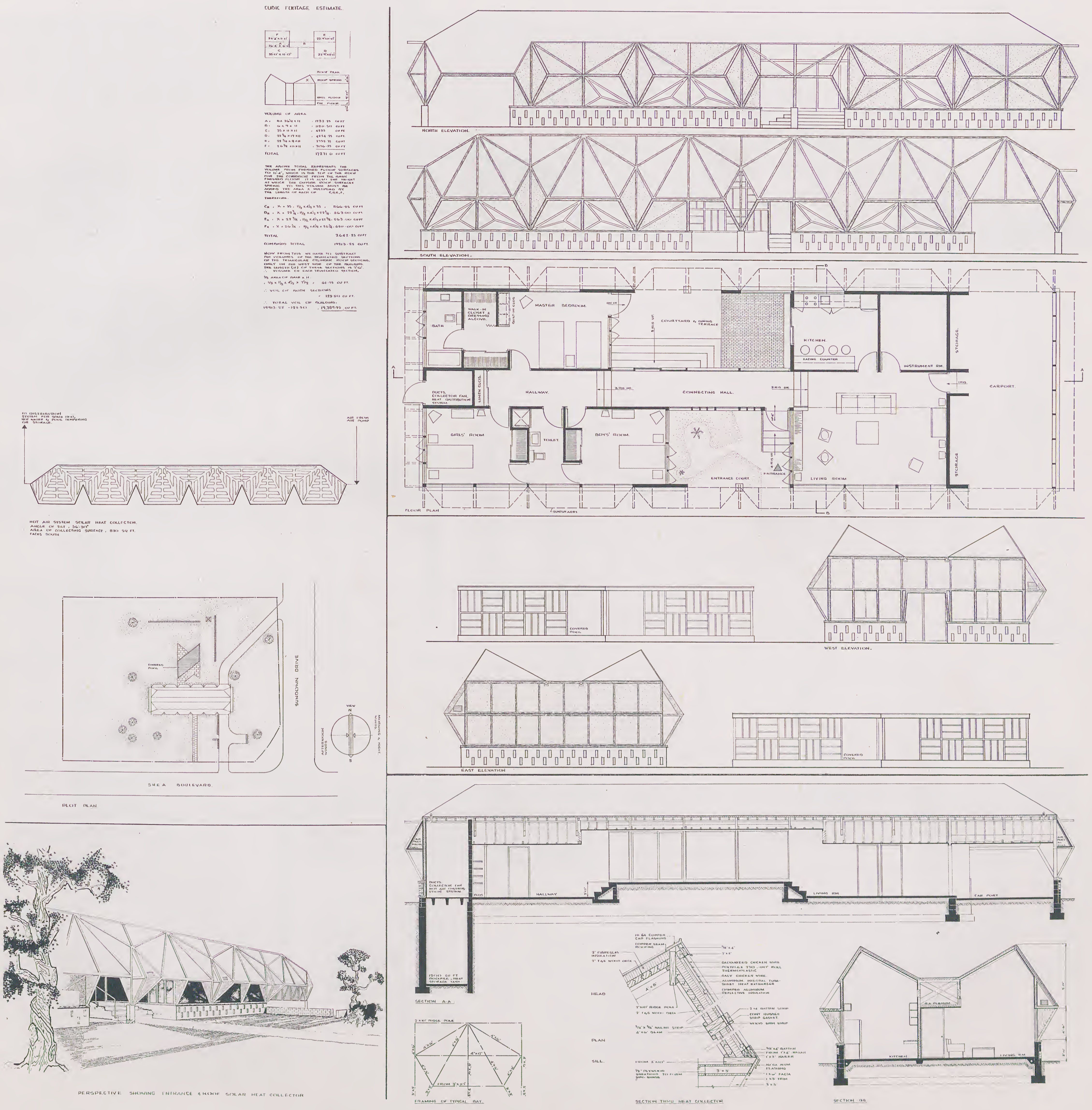
SOUTH ELEVATION



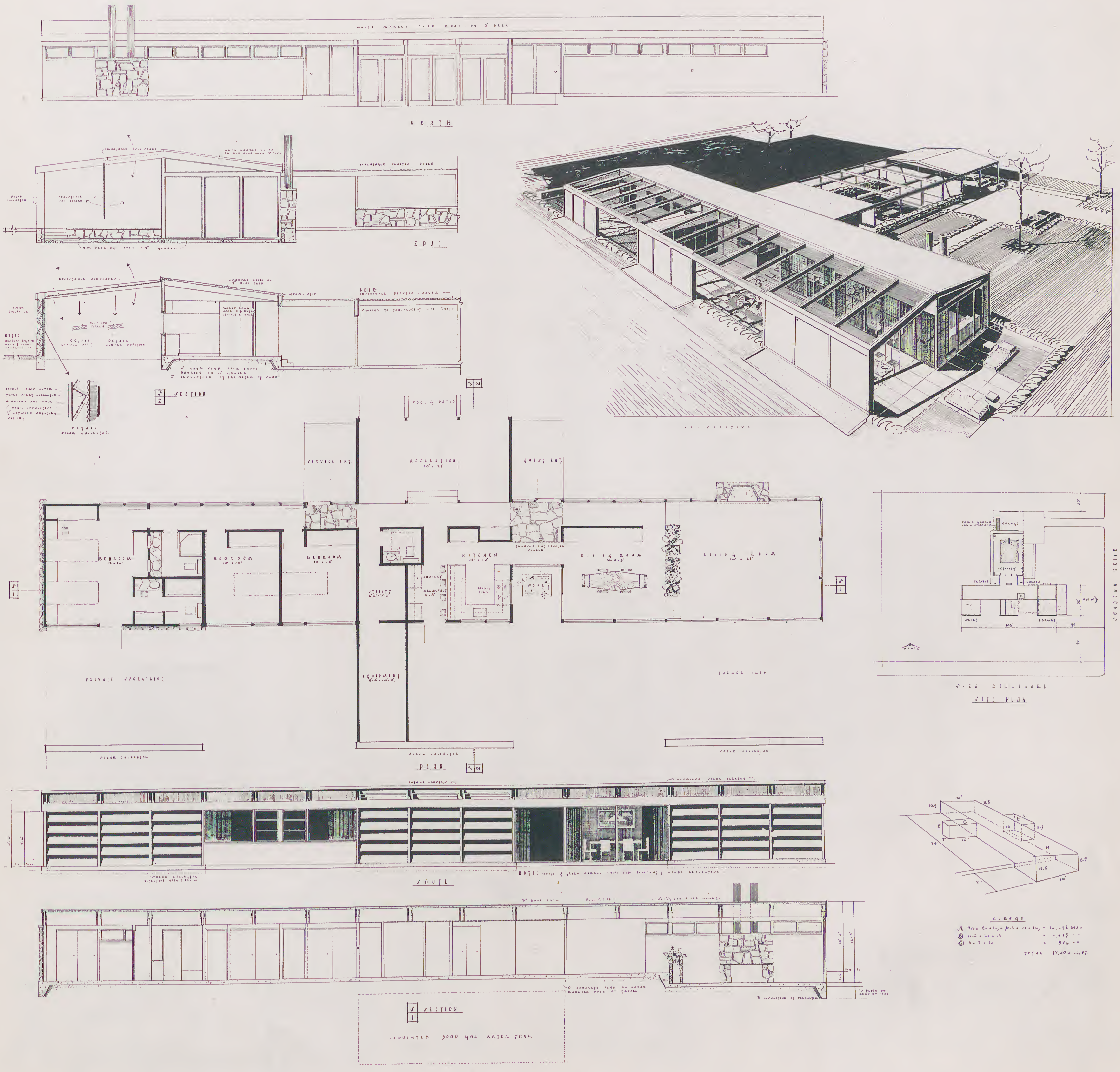
TRANSVERSE SECTION

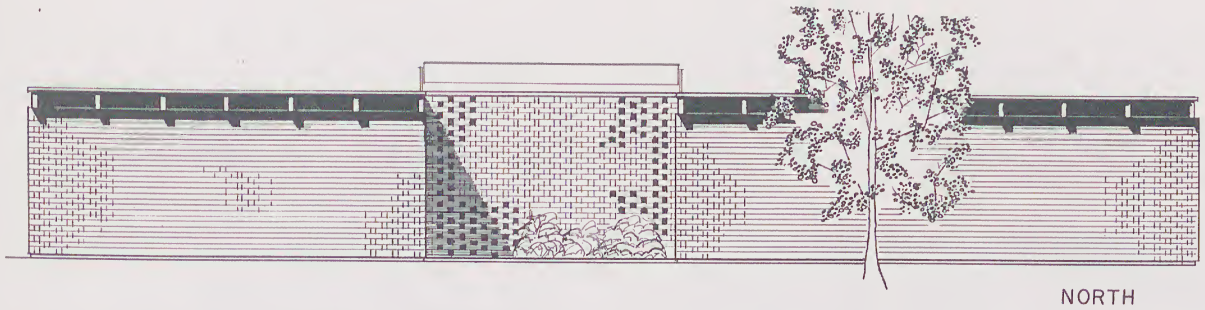


LONGITUDINAL SECTION

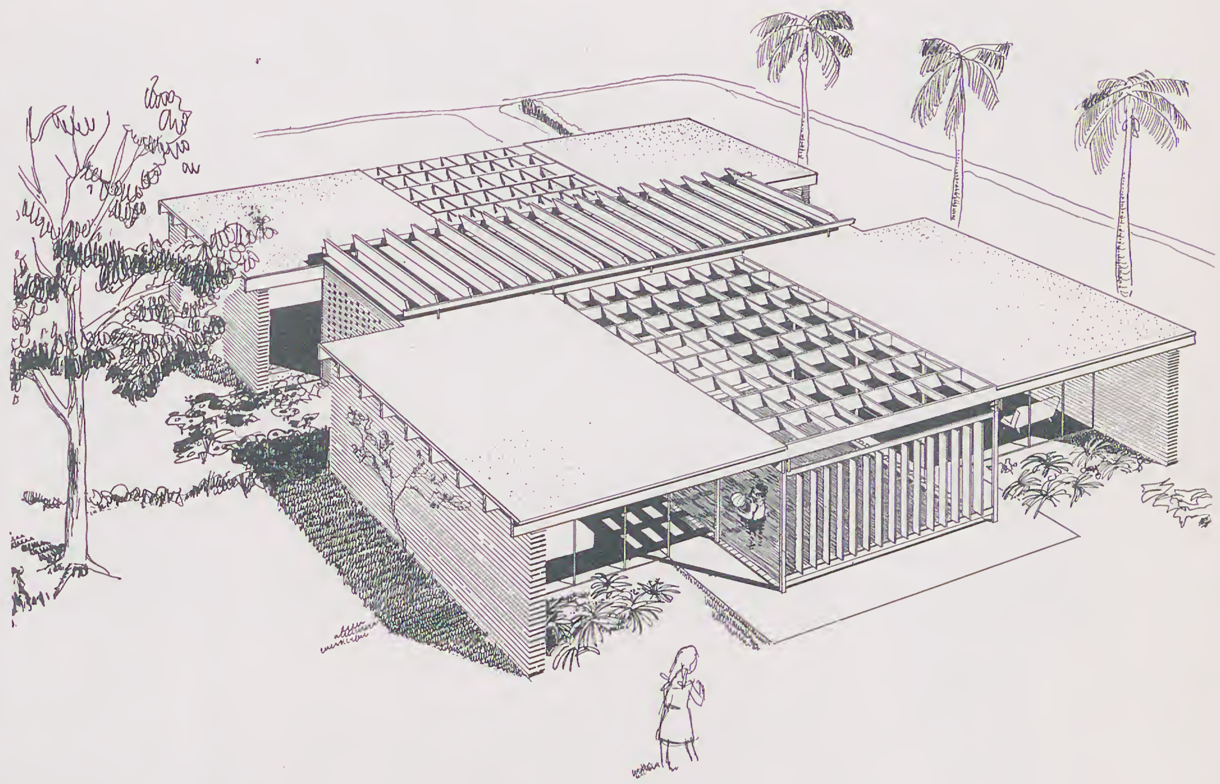

CUBIC FOOTAGE ESTIMATE
NORTH ELEVATION
SOUTH ELEVATION
MASTER BEDROOM
BATH
COURTYARD & DINING TERRACE
KITCHEN
EATING COUNTER
INSTRUMENT RM.
STORAGE
CARPORT
HALLWAY
CONNECTING HALL
LINEN CLOS.
GIRLS' ROOM
TOILET
BOYS' ROOM
ENTRANCE COURT
ENTRANCE
LIVING ROOM
FLOOR PLAN
HOT AIR SYSTEM SOLAR HEAT COLLECTOR
COVERED POOL
WEST ELEVATION
EAST ELEVATION
SUNDOWN DRIVE
SHEA BOULEVARD
PLOT PLAN
SECTION A-A
FRAMING OF TYPICAL BAY
SECTION THRU HEAT COLLECTOR
SECTION B-B
PERSPECTIVE SHOWING ENTRANCE & ROOF SOLAR HEAT COLLECTOR

14 D. E. COLUCCI, Canton, Ohio

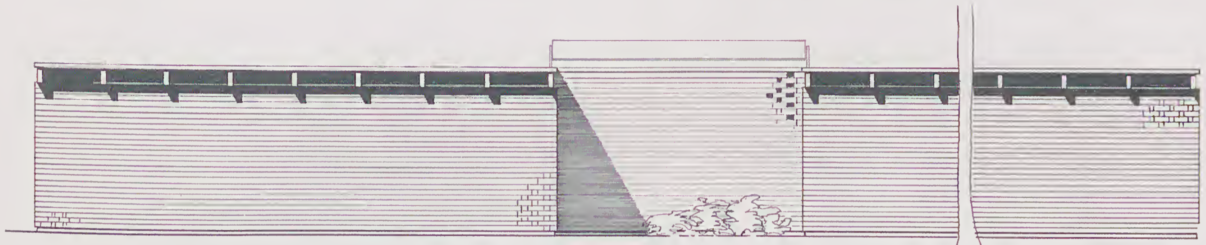




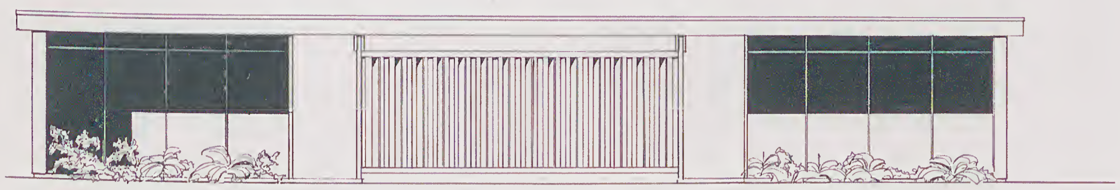
NORTH



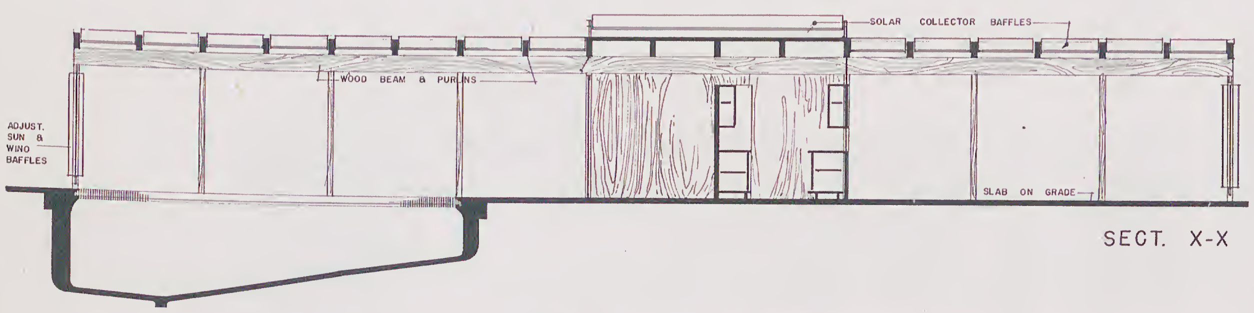
EAST



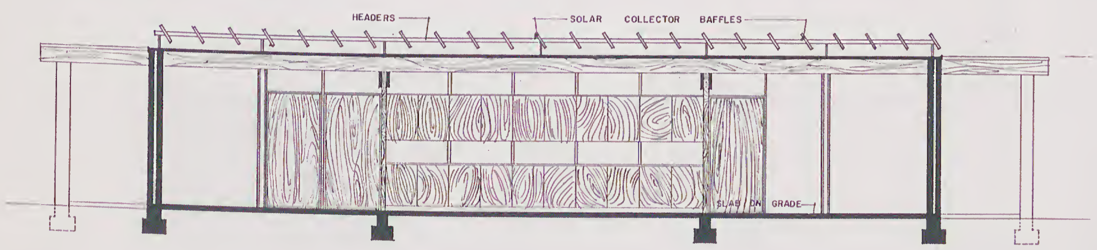
SOUTH



WEST

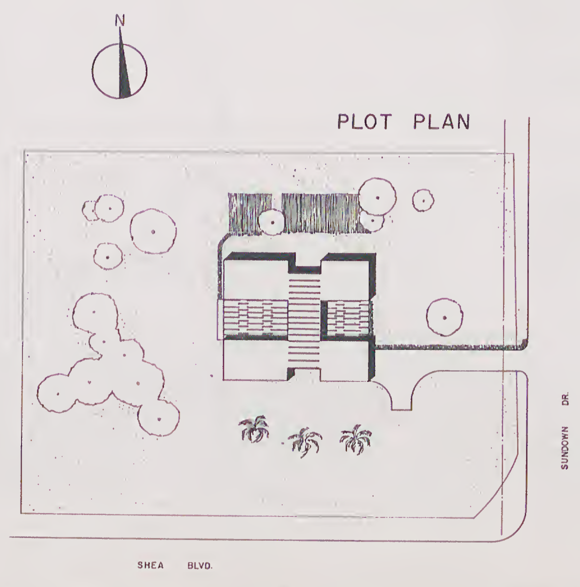


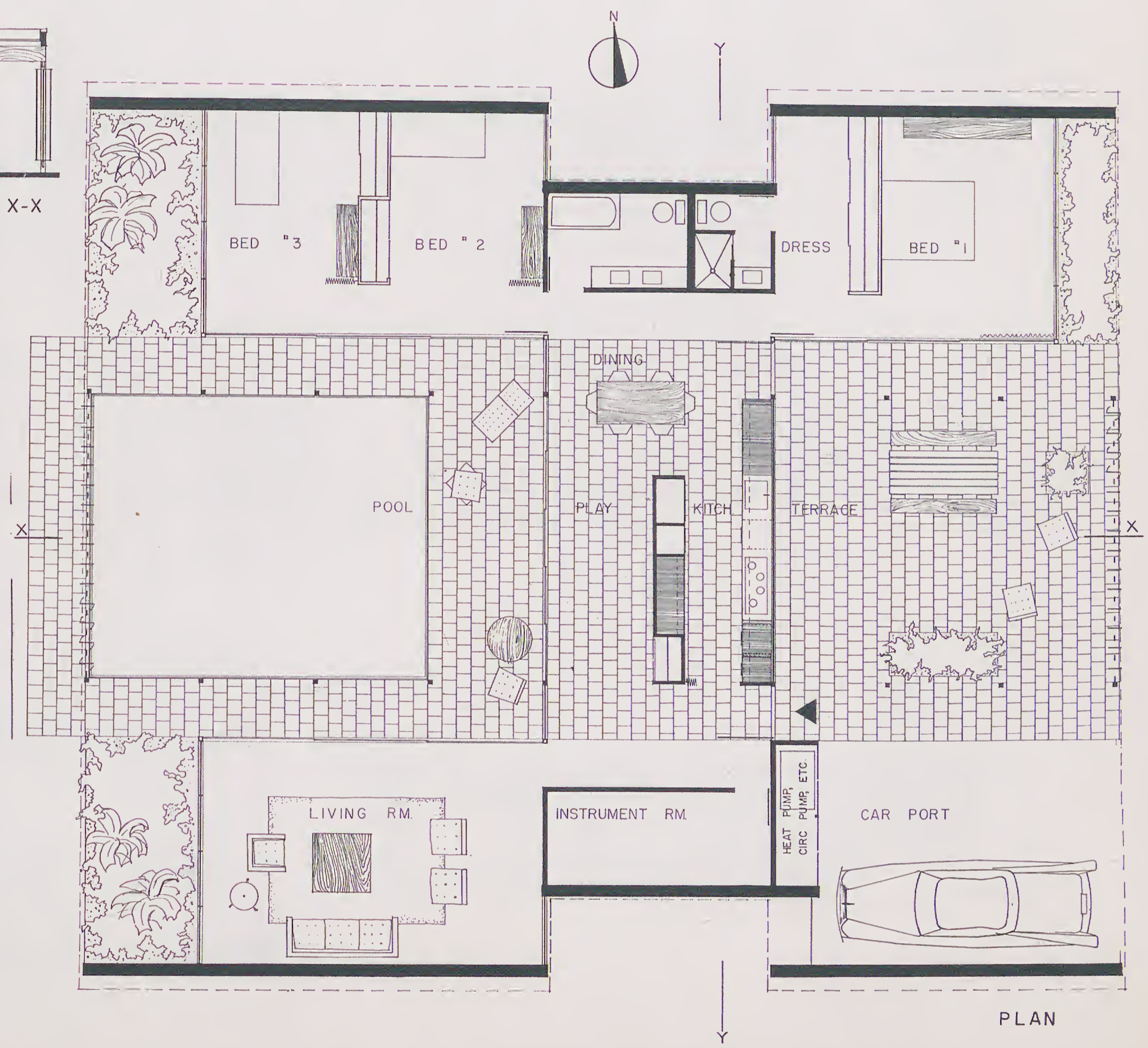
SECT. X-X



SECT. Y-Y

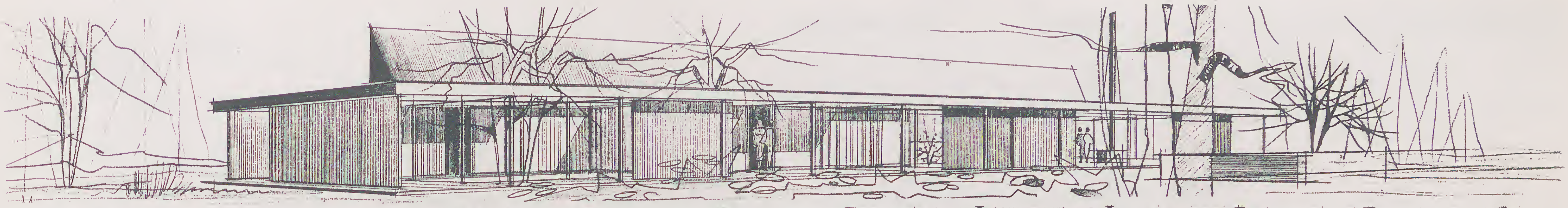
PLOT PLAN

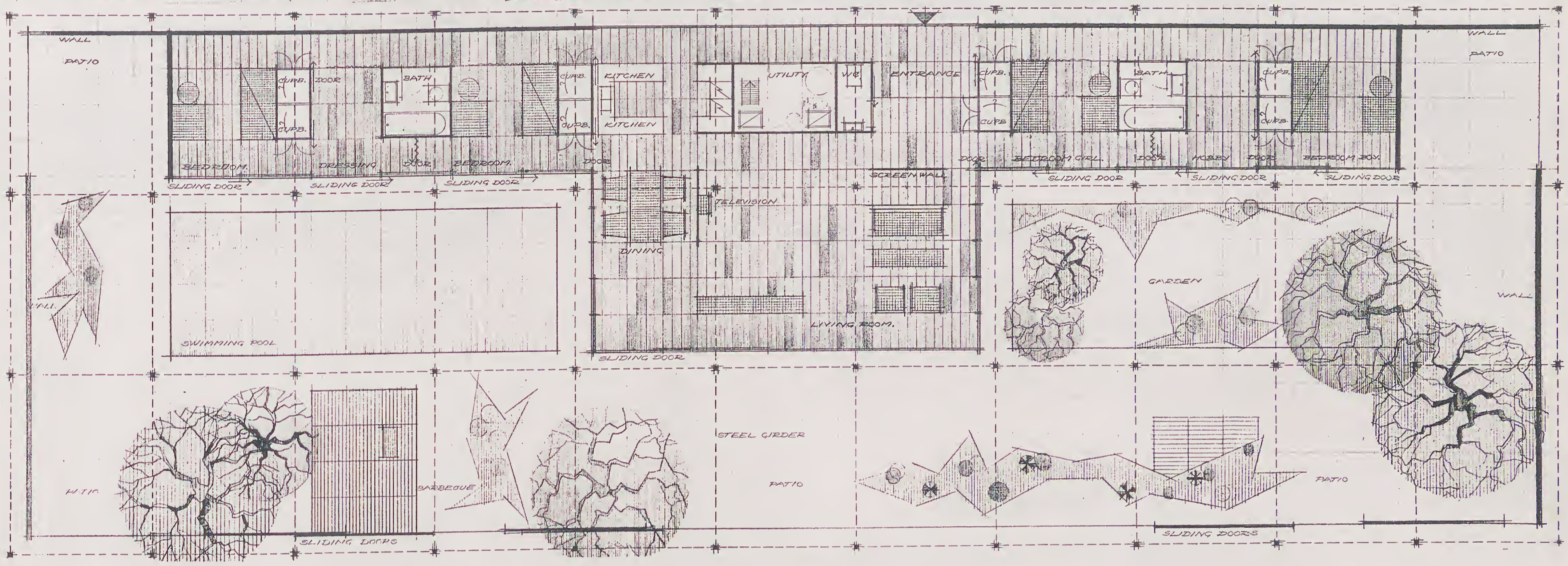


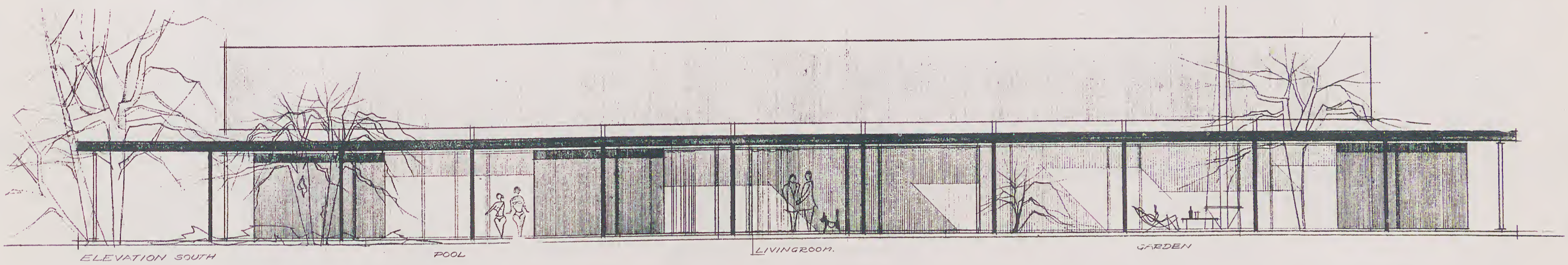


PLAN

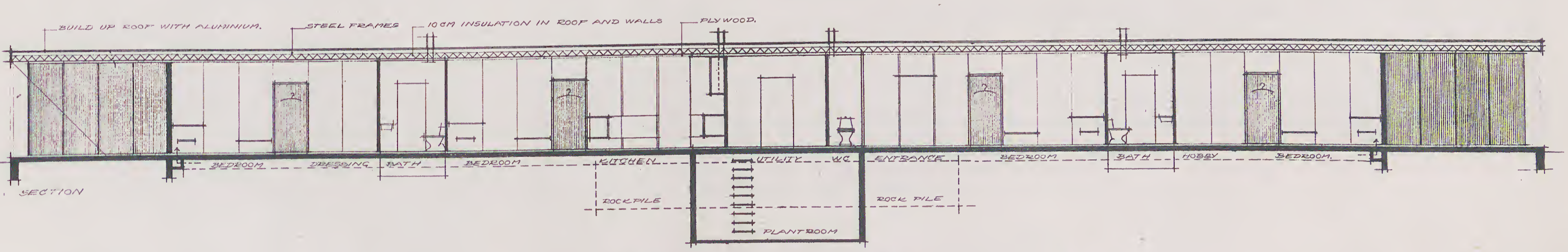
16 MOGENS DIDRIKSEN and C. E. SANDKIRK, Copenhagen, Denmark





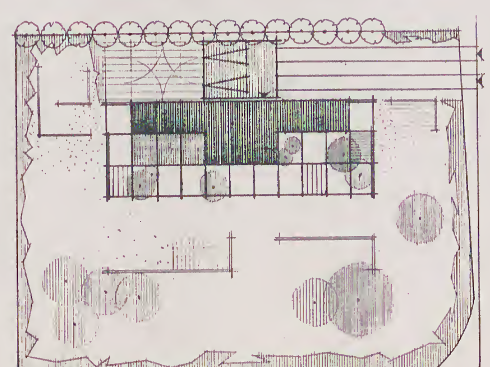


ELEVATION SOUTH

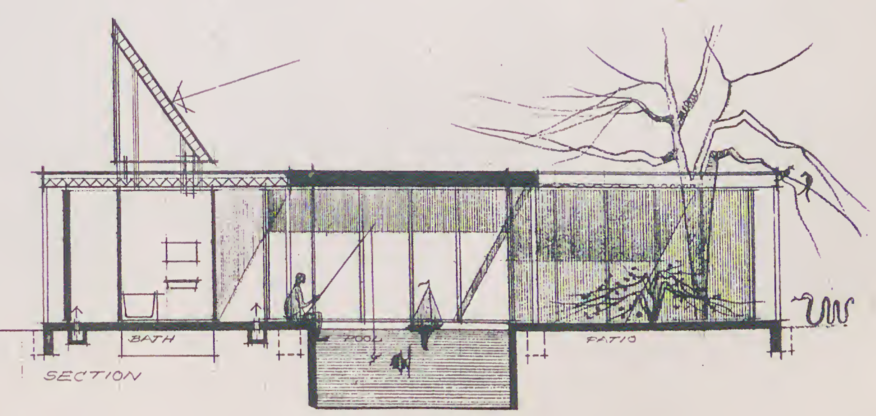


SECTION

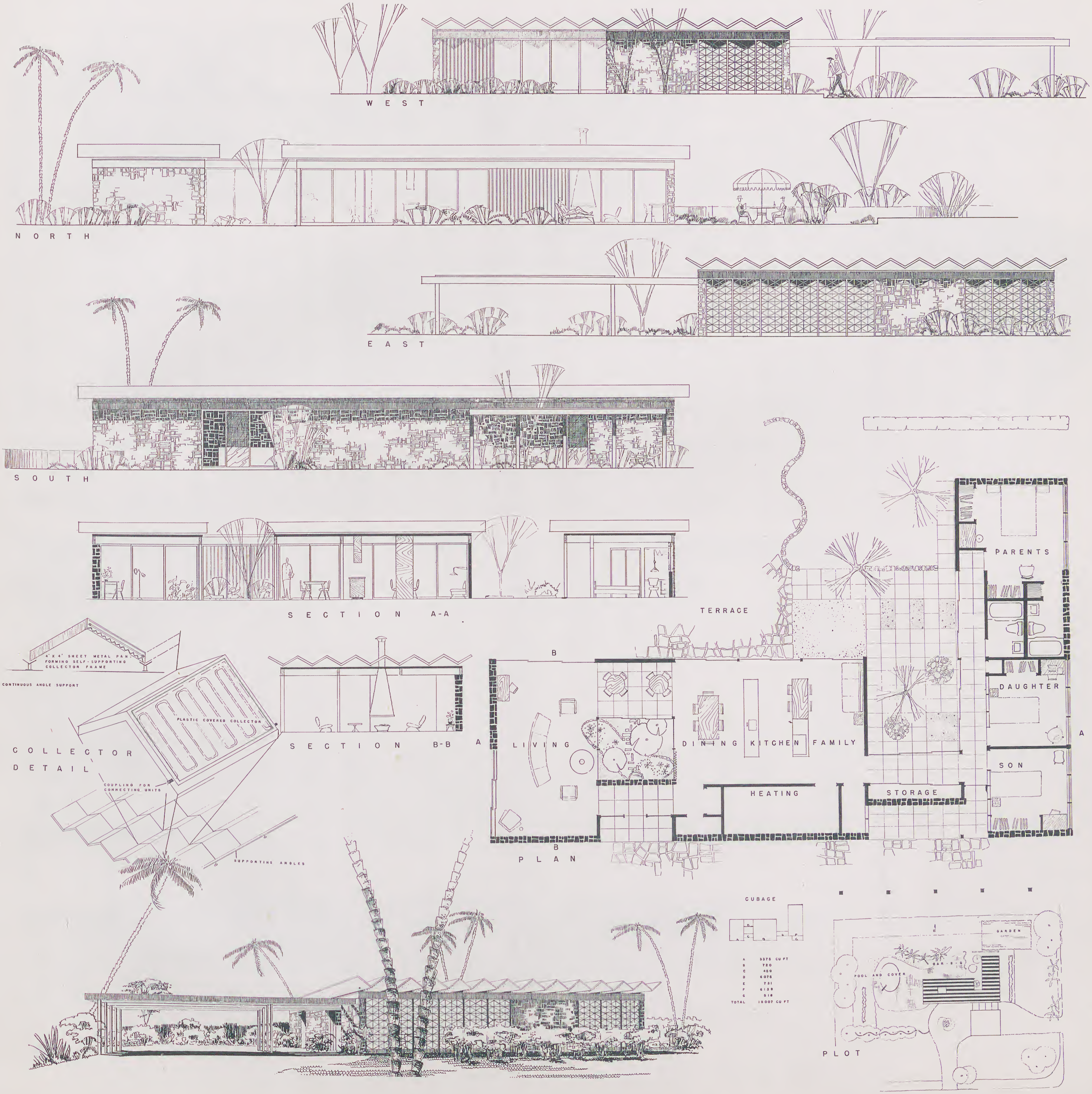
ELEVATION EAST AND WEST



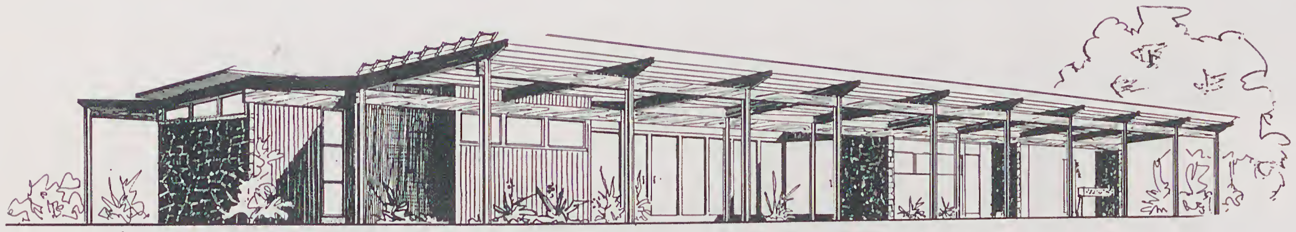
SITE PLAN

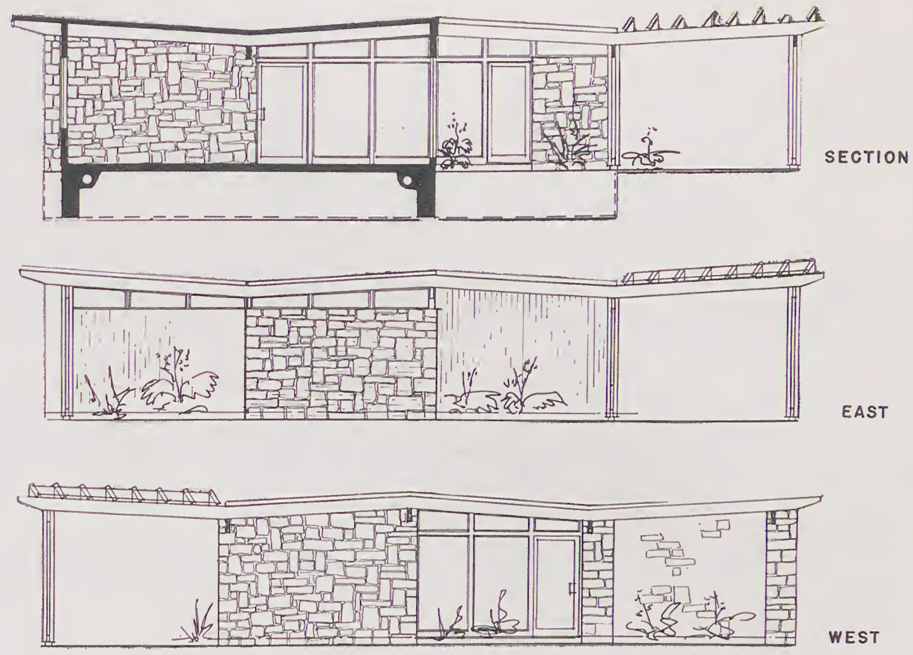


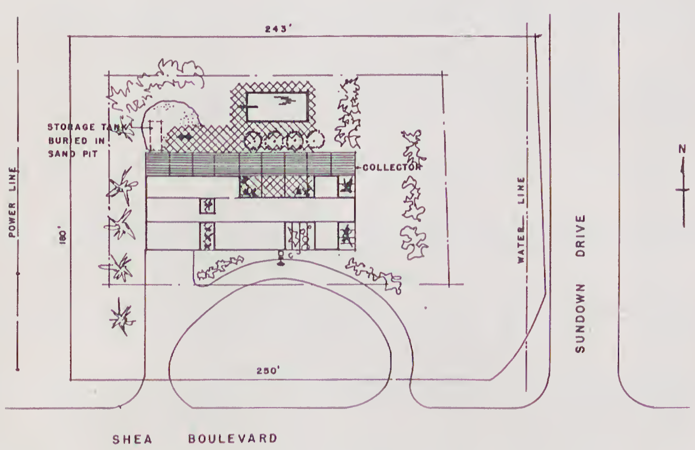
SECTION


WEST
NORTH
EAST
SOUTH
SECTION A-A
4' X 4' SHEET METAL PAN FORMING SELF-SUPPORTING COLLECTOR FRAME
CONTINUOUS ANGLE SUPPORT
PLASTIC COVERED COLLECTOR
COLLECTOR DETAIL
COUPLING FOR CONNECTING UNITS
SUPPORTING ANGLES
SECTION B-B
TERRACE
PARENTS
DAUGHTER
SON
LIVING
DINING
KITCHEN
FAMILY
HEATING
STORAGE
A
B
PLAN
CUBAGE
A 3375 CU FT
B 720
C 450
D 6075
E 731
F 6138
G 518
TOTAL 18007 CU FT
PLOT
GARDEN
POOL AND COVER

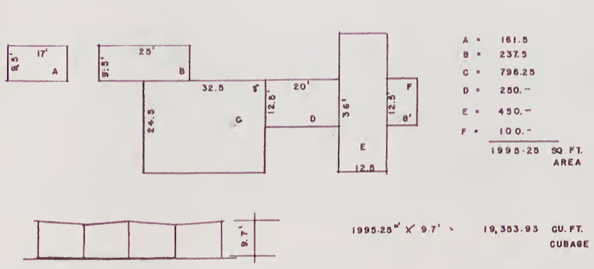
18 THADDEUS J. DULEMBA, Rochester, N.Y.

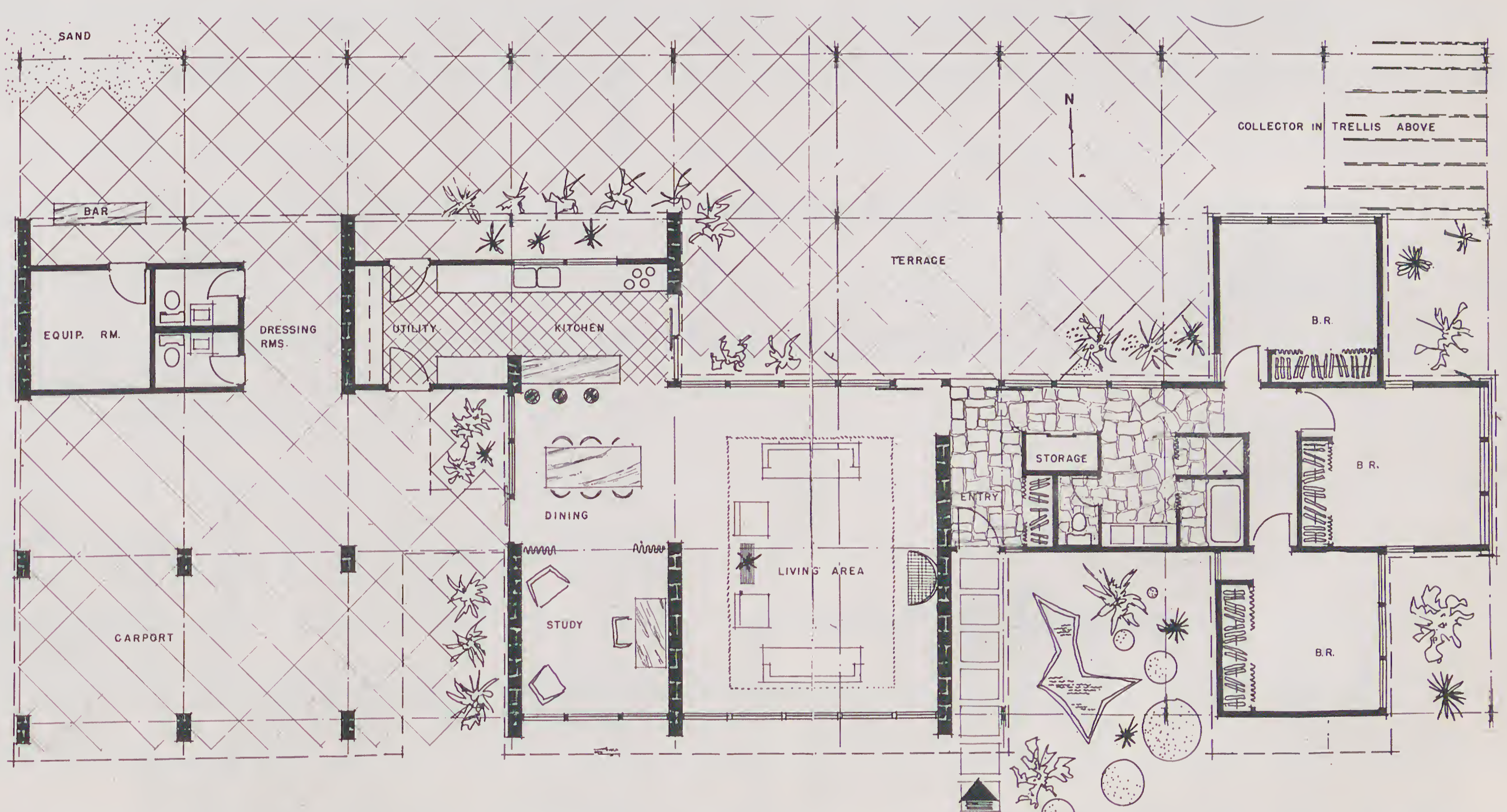






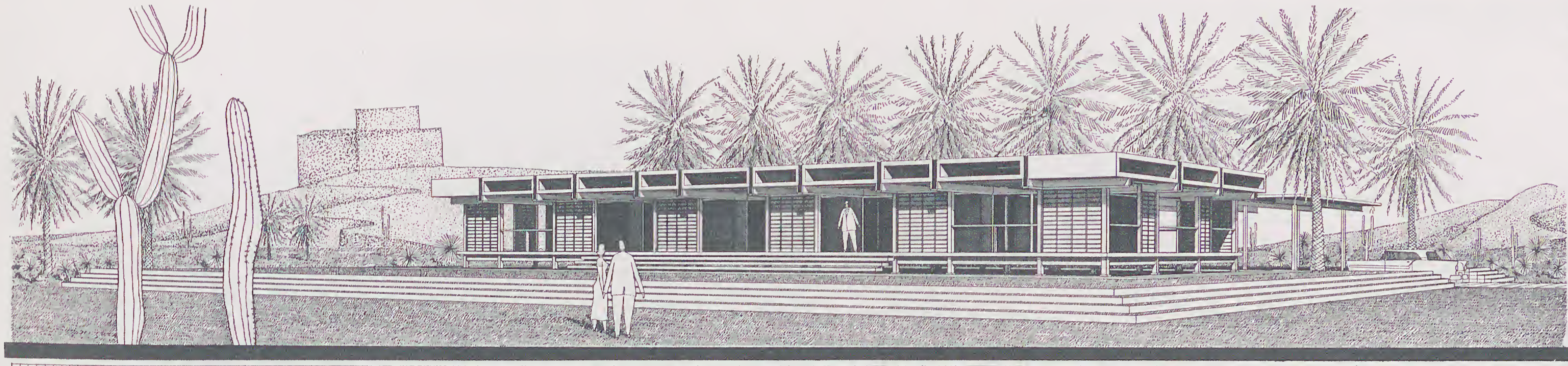
PLOT PLAN





FLOOR PLAN

MANUEL D. DUMLAO, Bloomfield Hills, Mich. 19



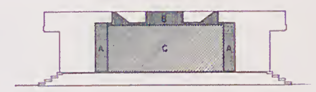
CUBAGE DIAGRAM

1226.04 CU. FT.

2790.10 CU. FT.

14800.00 CU. FT.

TOTAL = 18816.14 CU. FT.



NOTES

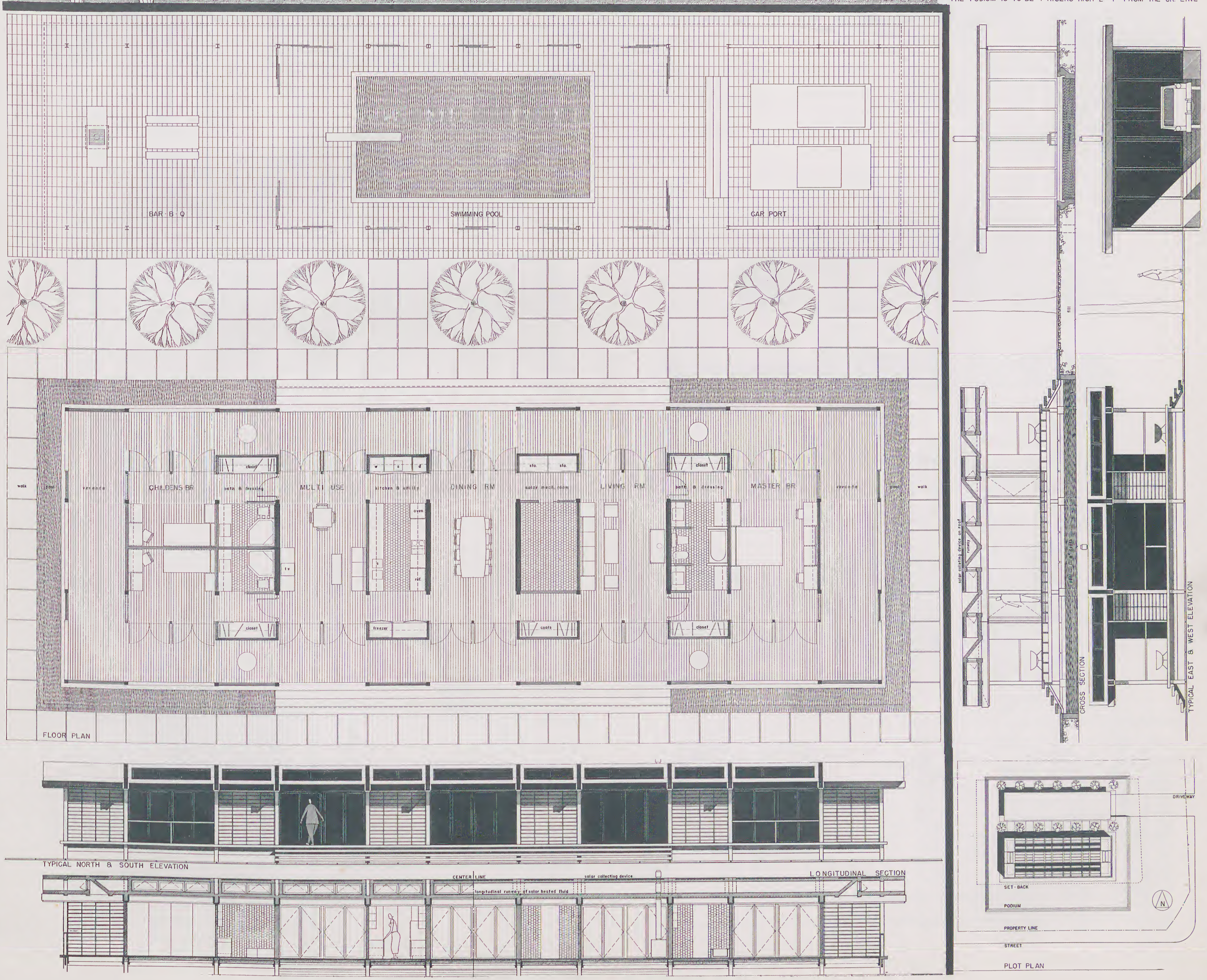
TOTAL AREA OF SOLAR HEATING DEVISE OF 2,067.50 SQ. FT···2,040.00 REQUIRED··· HAS BEEN PROVIDED ON A HORIZONTAL SURFACE FOR

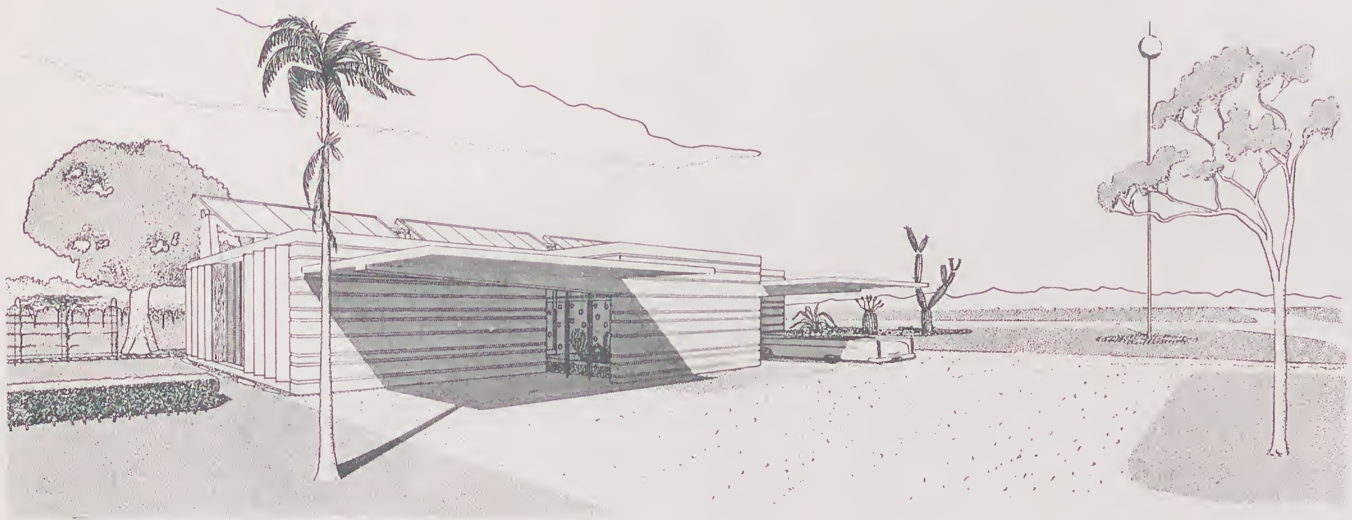
a. DOMESTIC WATER HEATING

b. SPACE HEATING

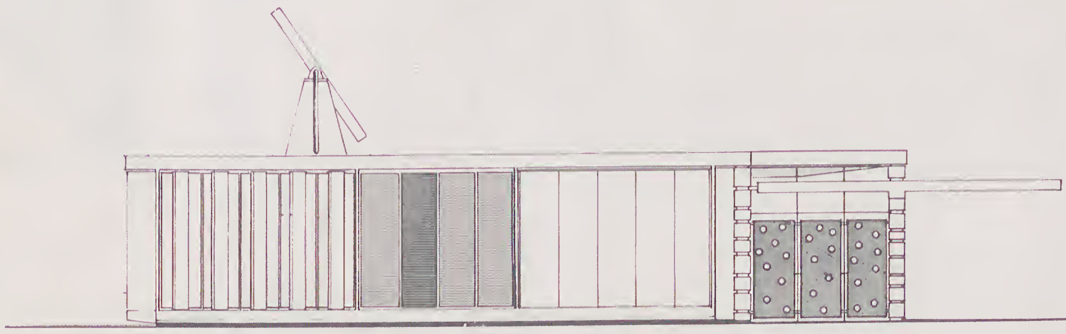
c. SWIMMING POOL HEATING

THE PODIUM IS TO BE 4 RISERS HIGH 2'-4" FROM THE GR. LINE

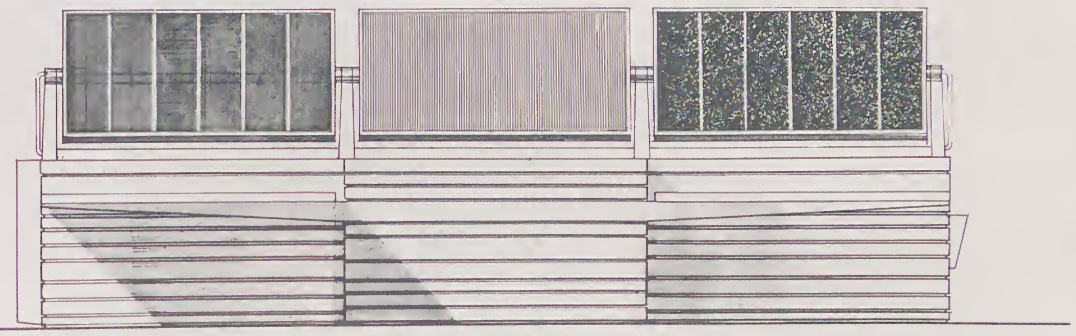




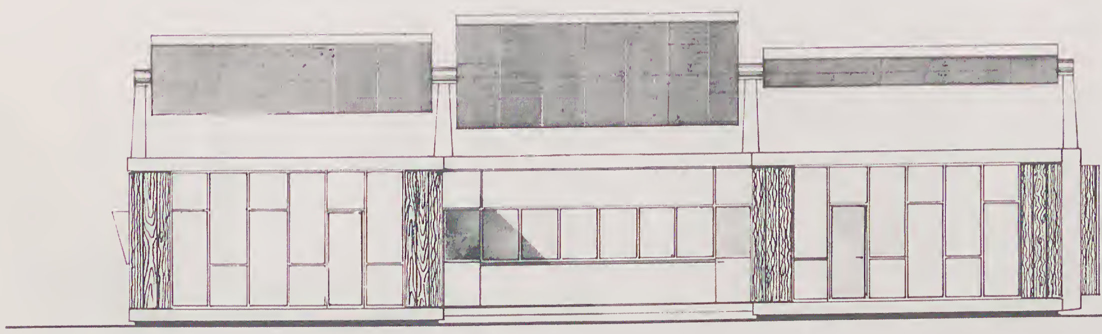
ELEVATIONS ▼



west



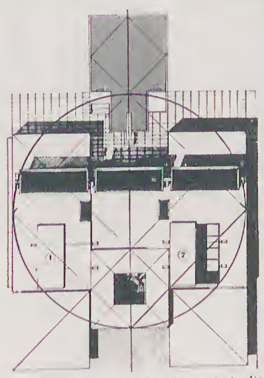
south



north

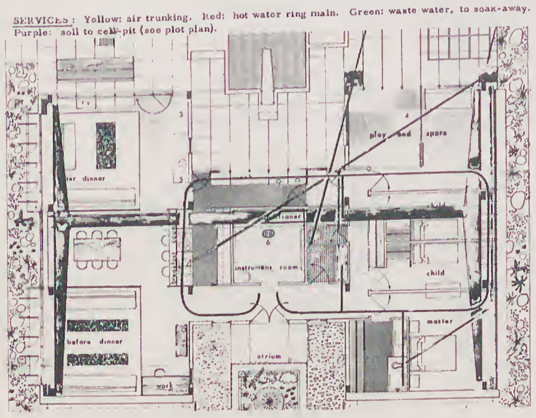
east

PROPORTION ▼ SERVICES ▼▼

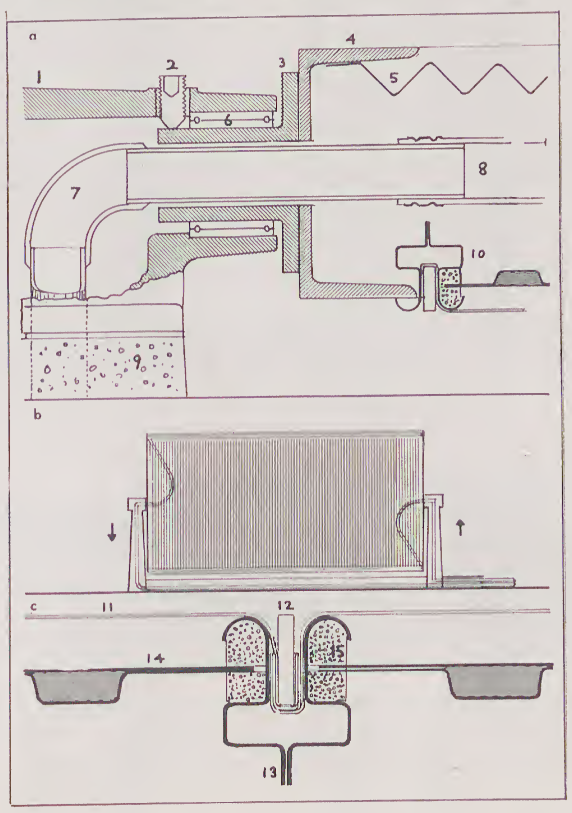


PROPORTIONAL CONTROL: The sign of the sun in the circle, and by implication the square. The elements of the house are related in three dimensions by the explicit or implicit rule of those two figures.

SERVICES: Yellow: air trunking. Red: hot water ring main. Green: waste water, to soak-away. Purple: soil to cell-pit (see plot plan).



COLLECTOR DETAILS ▼



KEY ▼

PERSPECTIVE

The spectral south wall and the gilded solar sphere proclaim in universal language the theme of the house.

ELEVATIONS (shown as at noon)

West: solar shutters and interference glazing shown open and closed.

West and South: Simultaneous calibration of equal areas of three different types of collector at identical inclinations.

North and East: Simultaneous calibration of identical collectors of equal area at three different inclinations.

COLLECTOR DETAILS

a. 1. Casting. 2. Set screw. 3. Flanged coupling. 4. R. S. channel frame. 5. Aluminium reflector. 6. Sleeve bearing. 7. Elbow. 8. Flexible coupling to header. 9. Concrete support. 10. Pressed glazing bar (see c).

b. Flow diagram.

c. 11. Weather resistant plastic film. 12. al. bar maintains film tension by spring coupling. 13. glazing bar. This has been designed for press-brake forming with standard tools to avoid cost of set of steel rolls (unjustified for prototyp
14 heater plate.

FURTHER SECTIONS (Necessary to explain scheme, Conditions Clause 20. D.)

1. R. S. section enclosing Teflon slide-extrusion. 2. aluminium reflective surface (preferably gold anodie. 3. Flexible P. V. C. draught excluder. 4. Foam concrete sawn to height painted spectral colours (or glass mosaic budget permitting). 5. Course formed by double strips of rough-cut rough-cast ¾" glass. 6. adhesive joint. 7. reflective al. roof. 8. Celotex on t. & g. 9. al. foil. 10. glass wool. 11. Nylon brush draught excluders (commercially available). 12. foam plastic. 13. lead cover-strip.

CUBE ▼▼

CUBIC VOLUME.

Cubic volume measured from finished floor level:

V_1 = 2(20 x 40 x 9'9") + (20 x 20 x 8'3")

= 19,150 cubic feet.

If volume enclosed by movable shutters on West Wall be included, then:

V_2 = 19,570 cubic feet.

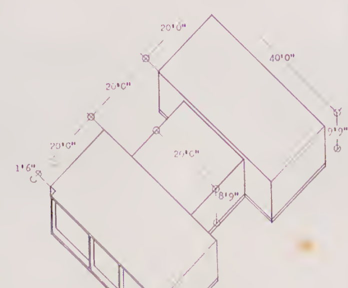
Note: according to the Conditions, Clause 17, the following are NOT included in the cubic volume:

1) Covered entrance porch or atrium.

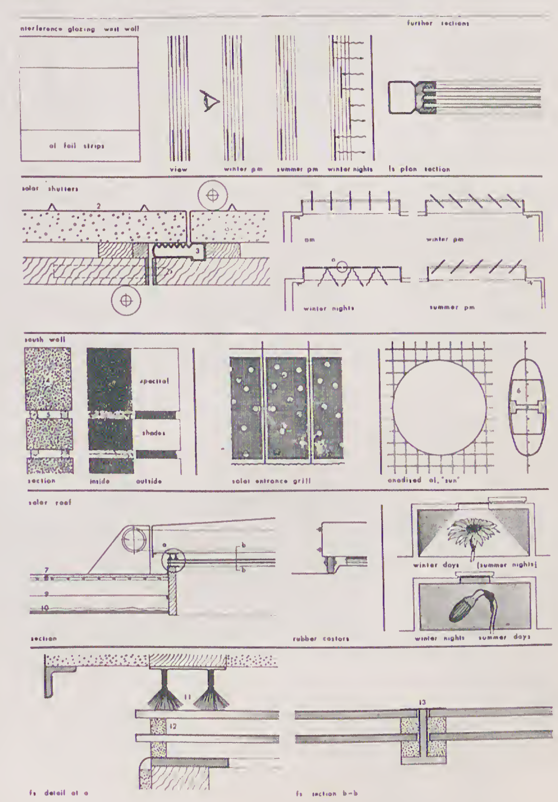
2) 2 car ports.

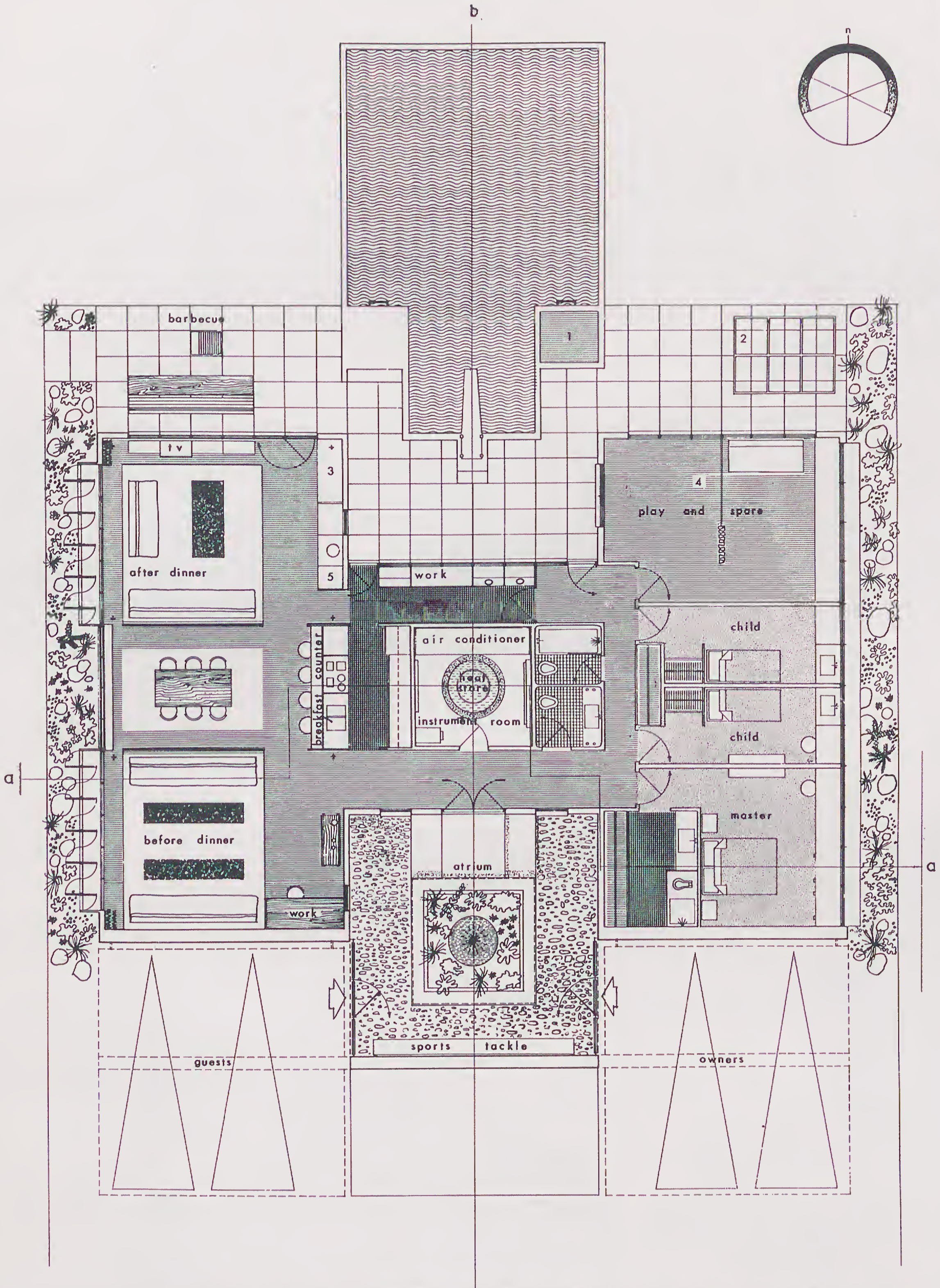
3) 3 foot crawl space beneath floor for access to services.

4) Pool water store. (This replaces at lower cost the alternative of an enclosed pool).

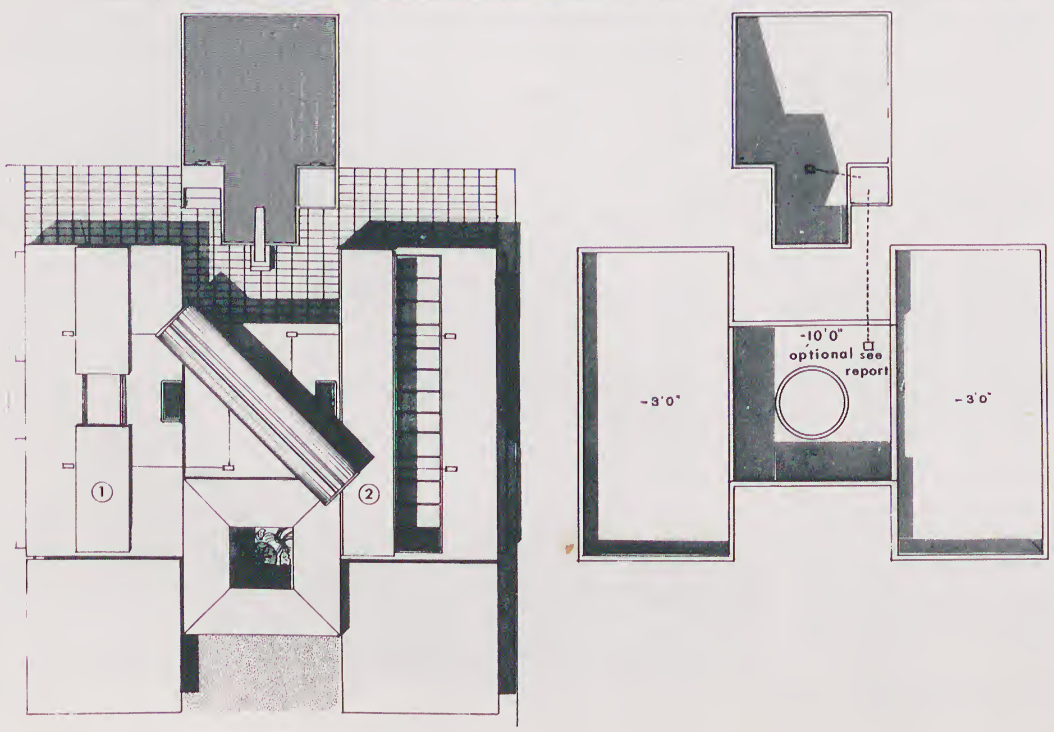


FURTHER SECTIONS ▼

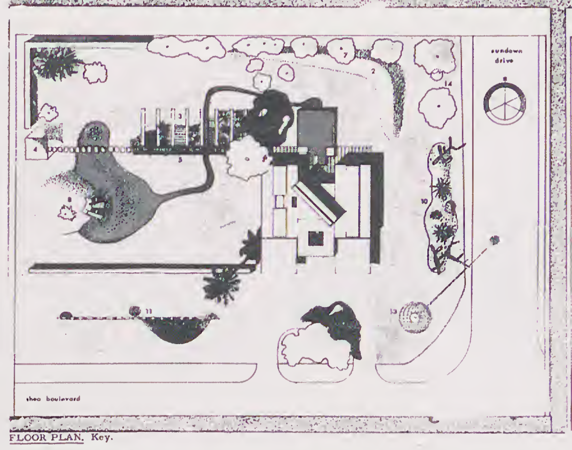


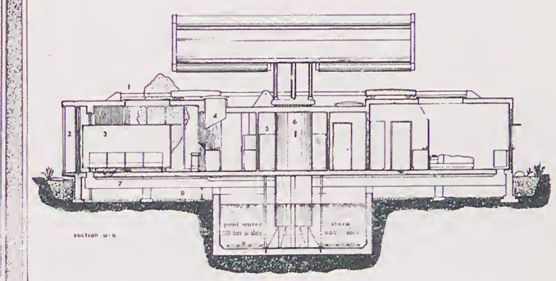


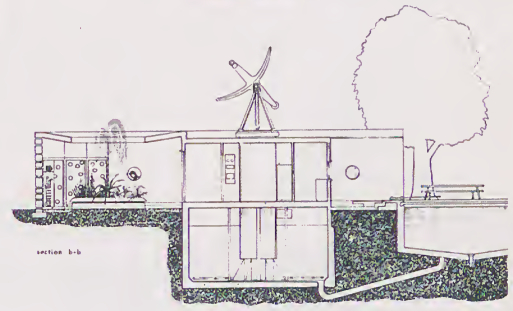
PLAN ▲ ROOF PLAN ▼ EARTH PLAN ▼



PLOT PLAN ▼ KEY ▼▼ SECTIONS ▼







FLOOR PLAN. Key.

1. Pump and filtration under 2. Gymnastic frame. 3. Flower tokonoma. 4. Freely divisible space, playroom, hobby room, domestic, guest, etc. 5. Fireplace position if wanted. Note diameter of insulated tank in instrument room should be reduced to 3'8" (from 5'0" as shown).

PLOT PLAN. Key.

1. Bamboo plantation. 2. Bank for sun-bathing and pool privacy formed from excavation spoil. 3. cookin herbs and table flowers. 4. pavilion in shell concrete. 5. Vine or Bourgainvillier covered walk. 6. Mulberry shade tree. 7. Double cherries. 8. hillock from pond spoil, the two together symbolising in 3.D. the daily solar path. 9. night-scented stock under East windows. 10. cactus plantation. 11. Diurnal solar symbol in white and black gravel, "sun" in yellow and orange flowers. 12. blossoming tree, orange (Brazilian). 13. Solar symbol : 4 foot gilded sphere on 60 foot mast.

SECTIONS. Key

1. Solar roof open. 2. Solar shutters closed. 3. Marble screen exactly half illuminated at noon, light square, dark square. 4. Light in, smells out. 5. air conditioner. 6. heat store. 7. air trunk. 8. crawl space for maintenance and experimental installations.

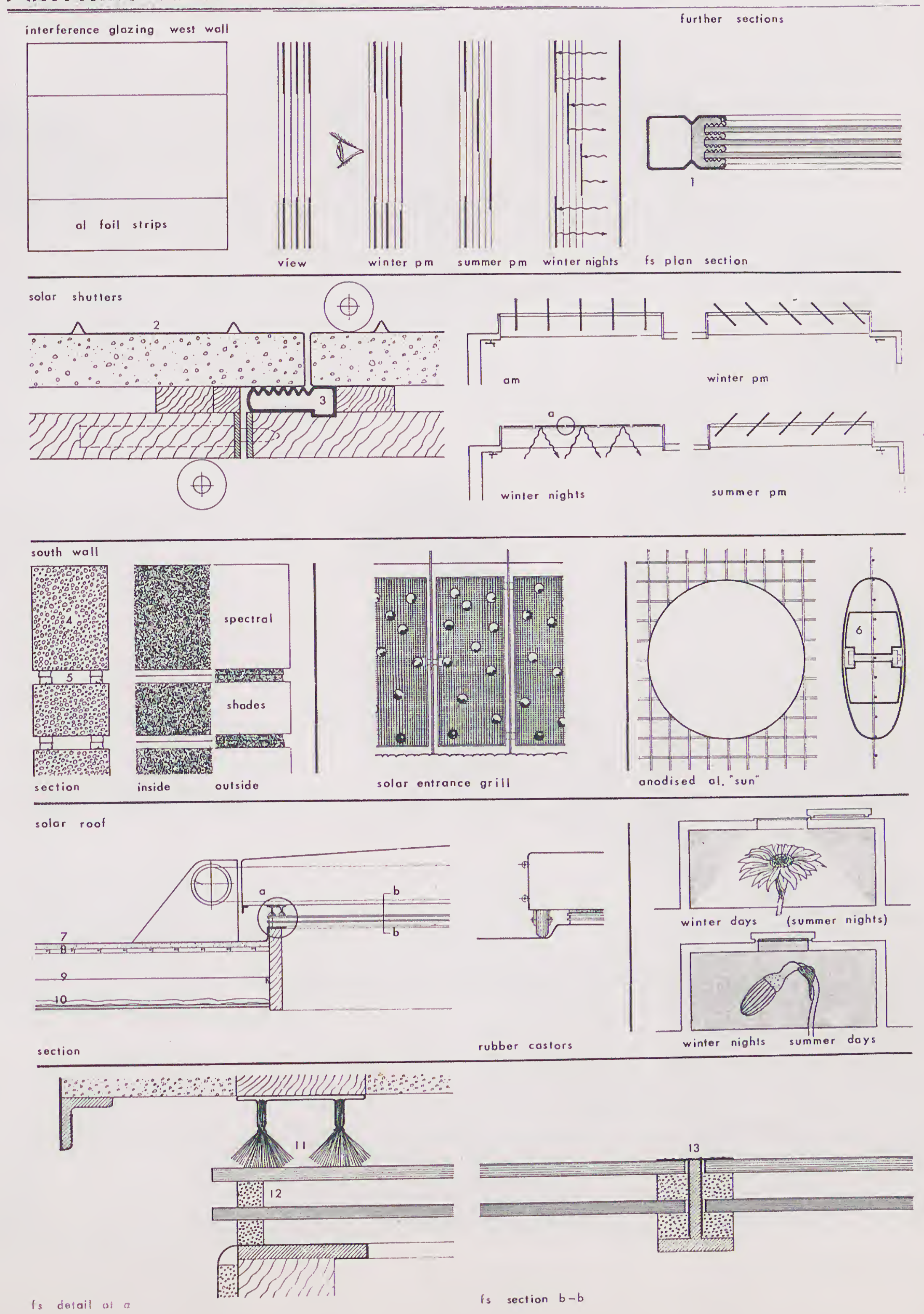
ROOF PLAN

1. Solar roof closed. 2. Solar roof open.

FURTHER SECTIONS

1. R.S. section enclosing Teflon slide-extrusion. 2. aluminium reflective surface (preferably gold anodis 3. Flexible P.V.C. draught excluder. 4. Foam concrete sawn to height painted spectral colours (or glass mosaic budget permitting). 5. Course formed by double strips of rough-cut rough-cast ¾" glass. 6. adhesive joint. 7. reflective al. roof. 8. Celotex on t. & g. 9. al. foil. 10. glass wool. 11. Nylon brush draught excluders (commercially available). 12. foam plastic. 13. lead cover-strip.

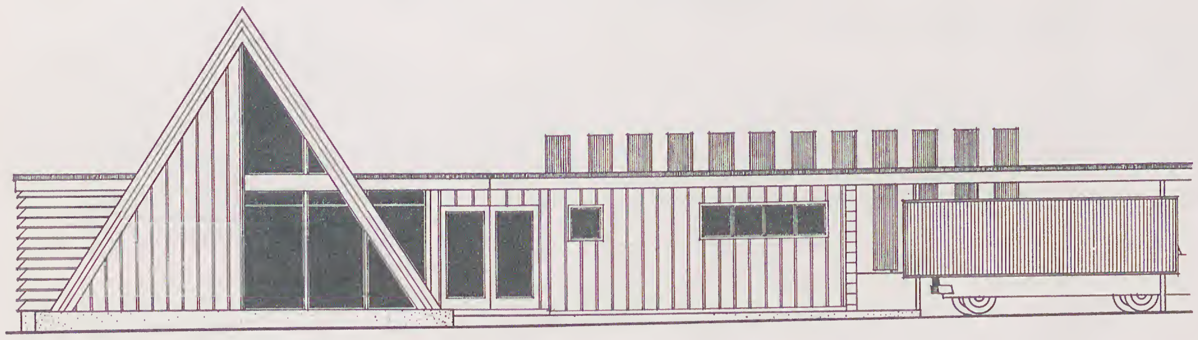
FURTHER SECTIONS



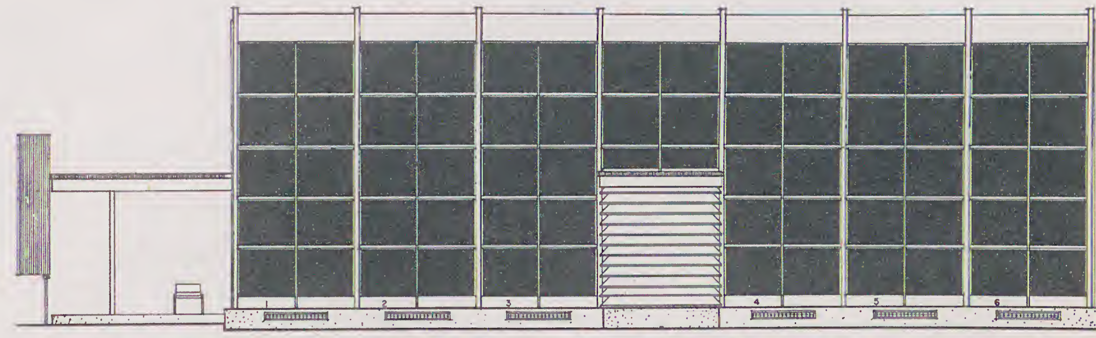
WILLIAM E. EVANS, Phoenix, Ariz.

NORTH ELEVATI'

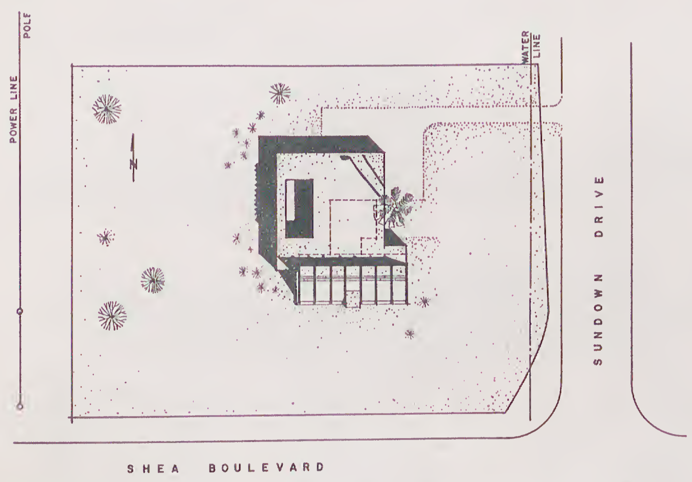
WEST ELEVATION



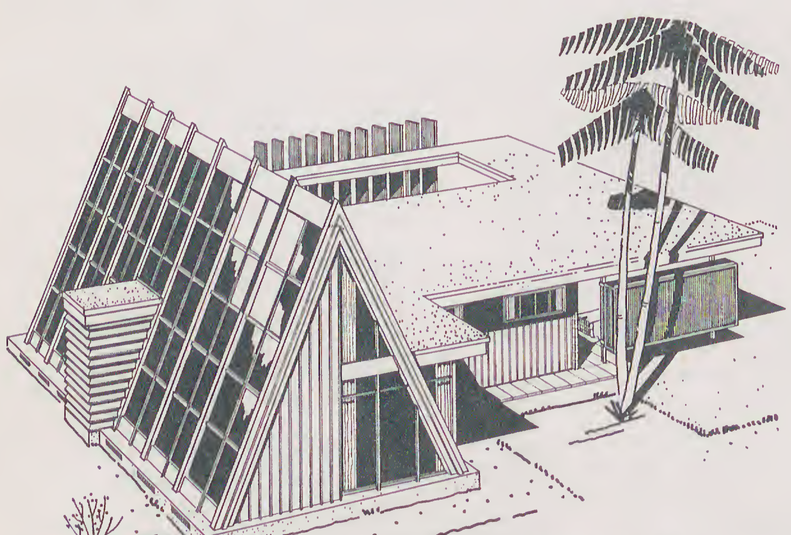
EAST ELEVATION



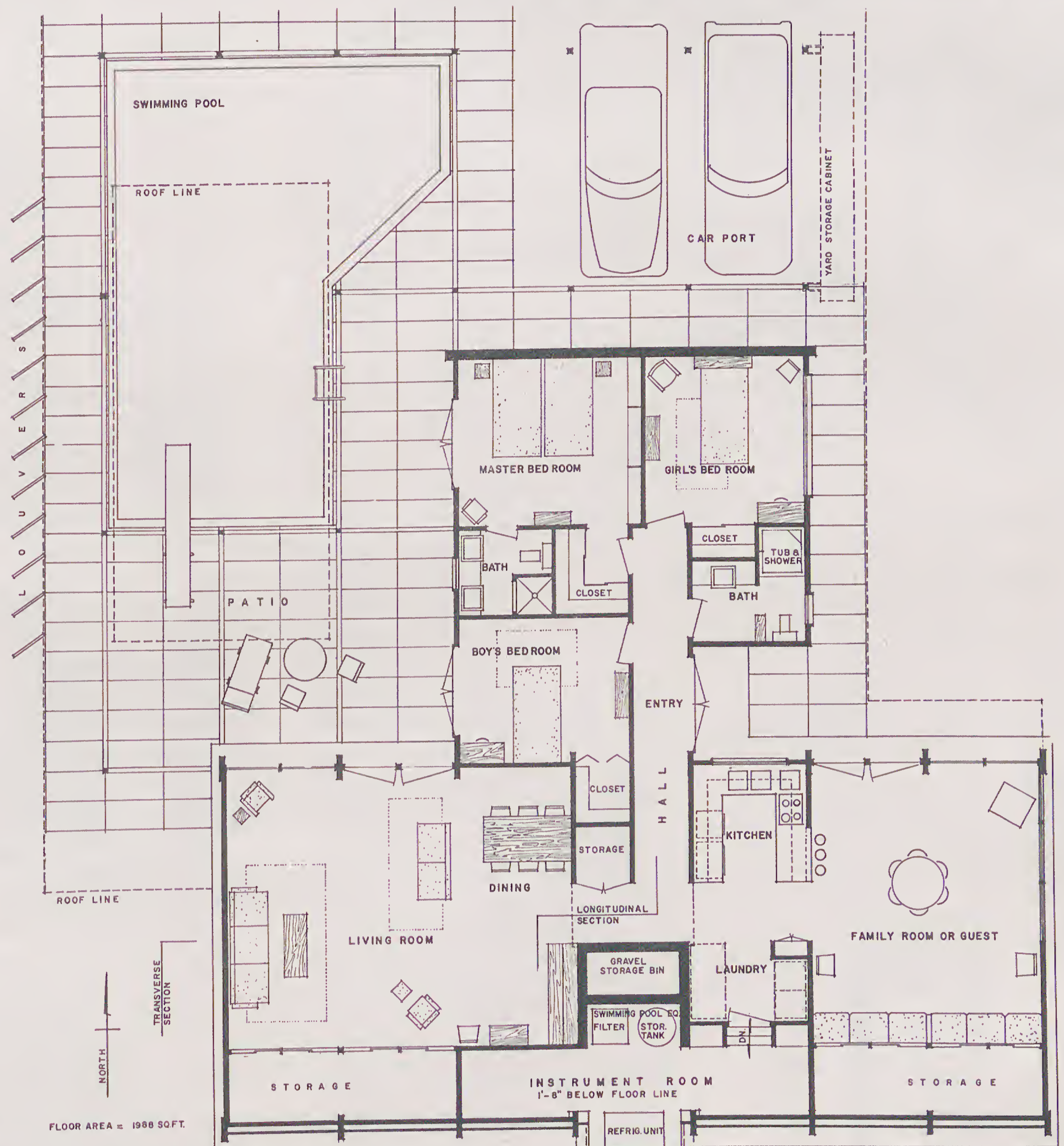
SOUTH ELEVATION



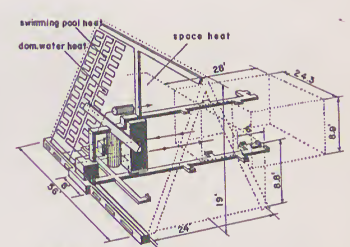
PLOT PL



PERSPECTIVE

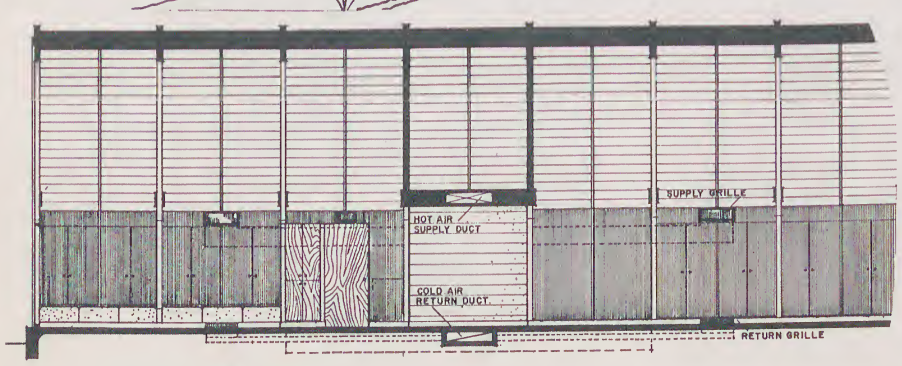


FLOOR PLAN

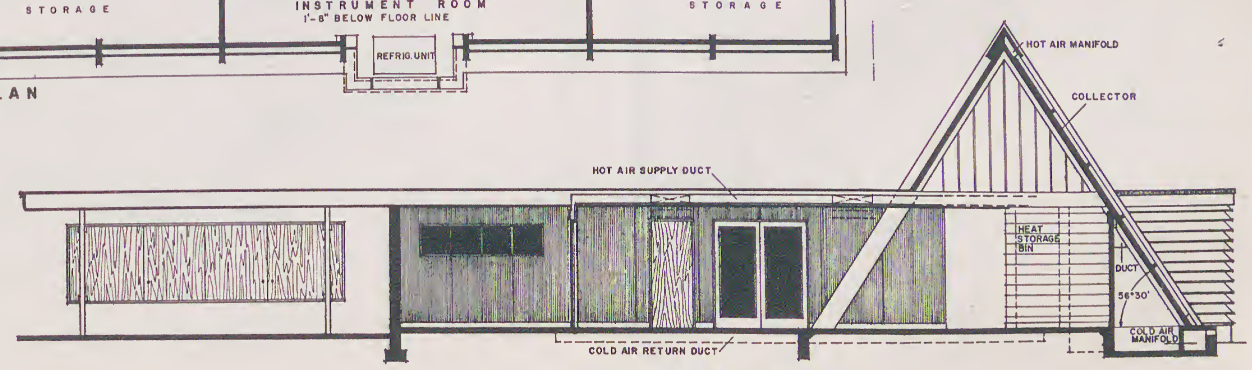


CUBAGE:

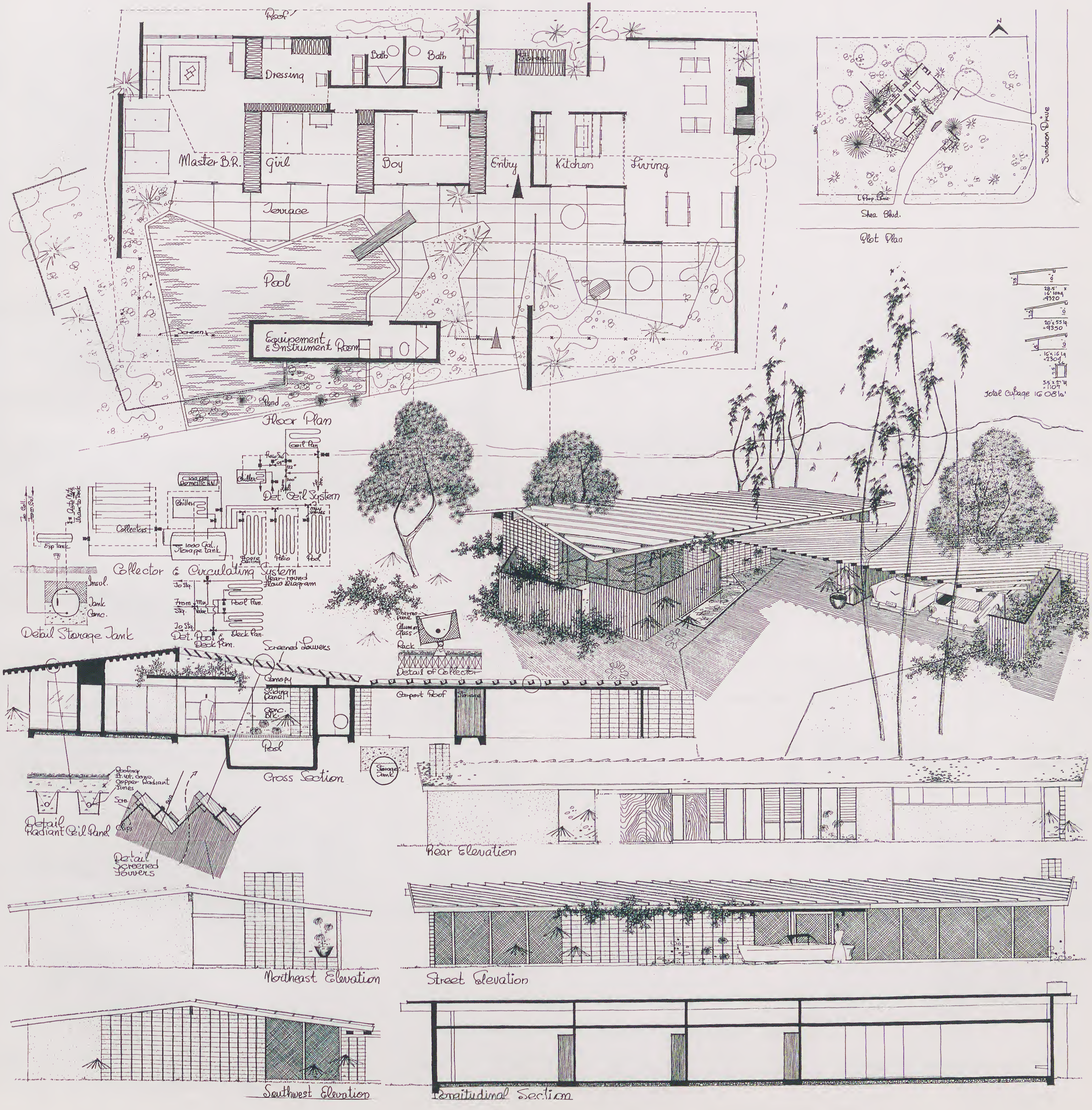
56×3×8.8	= 1,478
56×12×19	= 12,768
24.3×28×8.8−8×7.5×8.8	= 5,459
8×3×8.8	= 211
	19,916

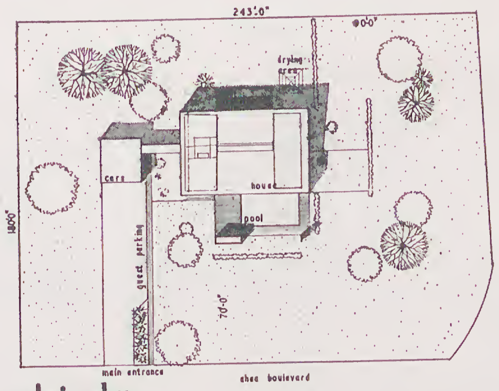


TRANSVERSE SECT



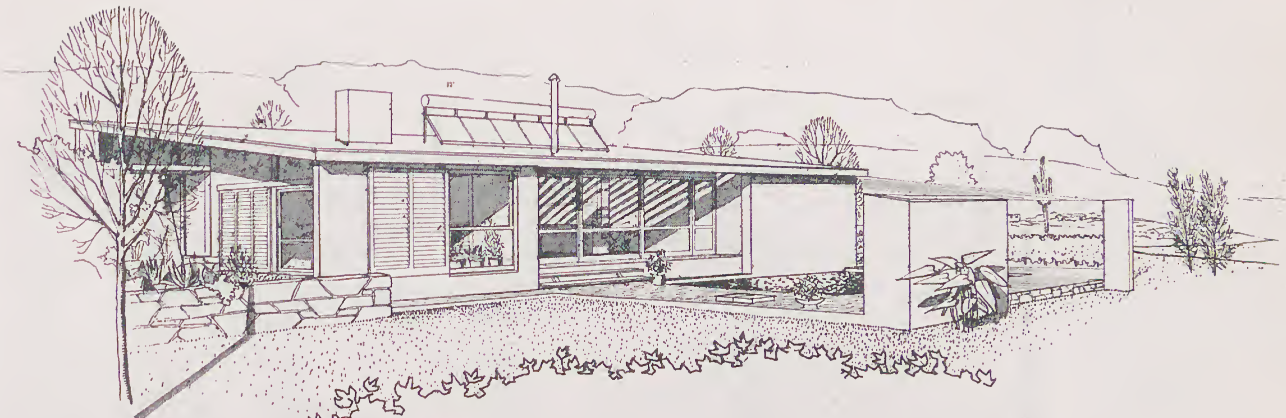
LONGITUDINAL SECTION


Roof
Dressing
Bath
Bath
Master B.R.
Girl
Boy
Entry
Kitchen
Living
Terrace
Pool
Equipement & Instrument Room
Pond
Floor Plan
Shea Blvd.
Plot Plan
Total Cubage 16081
Det. Ceil System
Chiller
Collectors
1000 Gal. Storage Tank
Collector & Circulating System
Year-round Flow Diagram
Detail Storage Tank
Det. Pool & Deck Pan.
Deck Pan.
Pool Pan.
Screened Louvers
Detail of Collector
Canopy
Sliding Panel
Carport Roof
Pool
Cross Section
Storage Tank
Detail Radiant Ceil Panel
Detail Screened Louvers
Rear Elevation
Northeast Elevation
Street Elevation
Southwest Elevation
Longitudinal Section

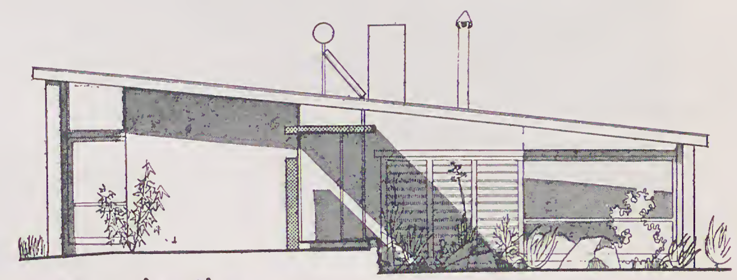


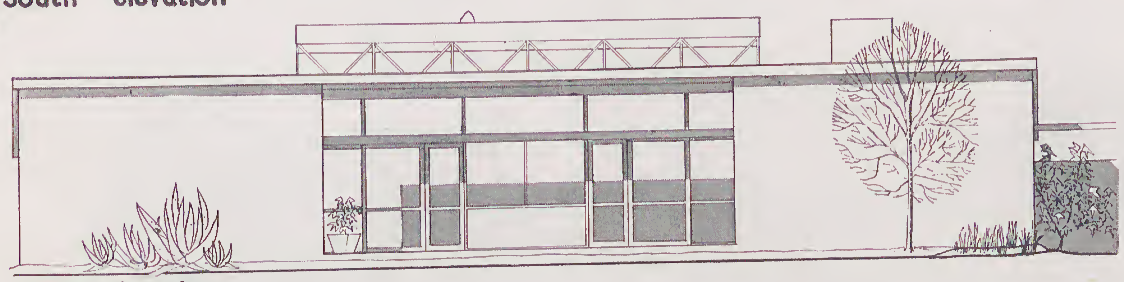
plot plan

north


view from the south west


south elevation


west elevation


north elevation

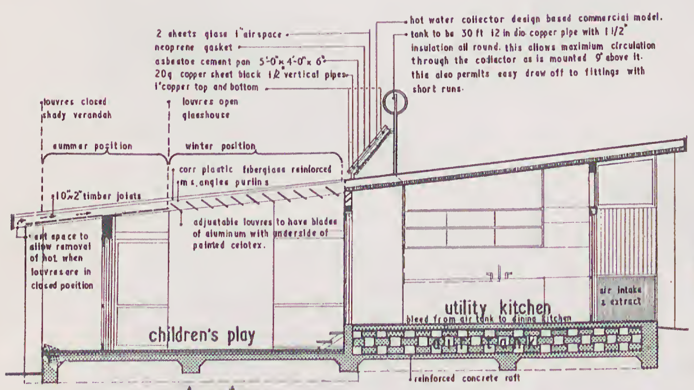

east elevation

FLOOR AREA.

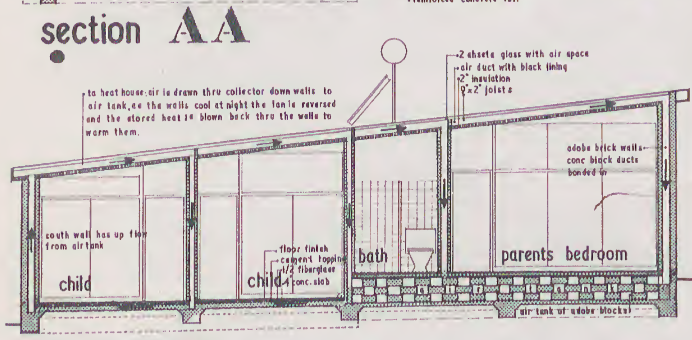
1.Children's Bedrooms	13'- 6"x 20'- 0"	- 270 sq.ft.
2.Living Room	13'- 6"x 20'- 0"	- 270 sq.ft.
3.Parents Bed & Baths	13'- 6"x 20'- 0"	- 270 sq.ft.
4.Entry & Guestroom	13'- 6"x 20'- 0"	- 270 sq.ft.
5.Kitchen Dining Etc.	15'- 0"x 29'- 0"	- 458 sq.ft.
6.Barbecue Playroom	15'- 0"x 20'- 0"	- 458sq.ft.
TOTAL		..................1098 sq.ft.

VOLUME CUBAGE.

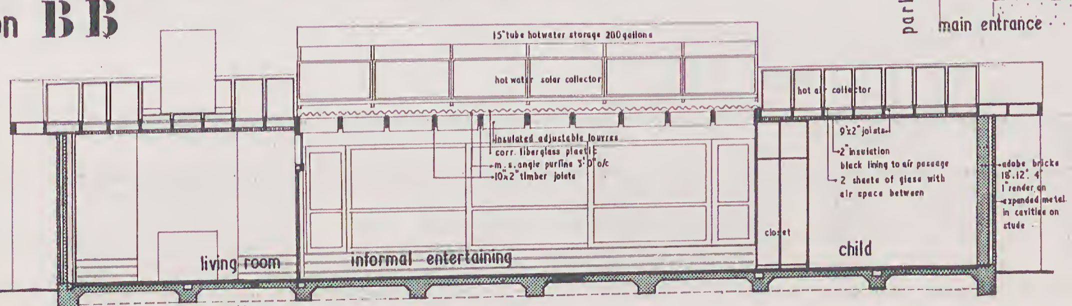
1.Ceiling	8'to 10' av 9'- 270x9 -	2430cub.ft.
2.ceiling	ditto. ditto. -	2430cub.ft.
3.Ceiling	8'-0" to 10'-0" av. 9'-0" -	2570cub.ft.
4.Ceiling	ditto. ditto. -	2570cub.ft.
5.Ceiling	8'-0"to 10'-3" av.9'-4½" -	4250cub.ft.
6.Ceiling	8'-6"to 10'-0" av.9'-3" -	4228cub.ft.
TOTAL	....	18484cub.ft.
Roof 9" thick 2000sq.ft.		1500cub.ft.
TOTAL	....	19984cub.ft.



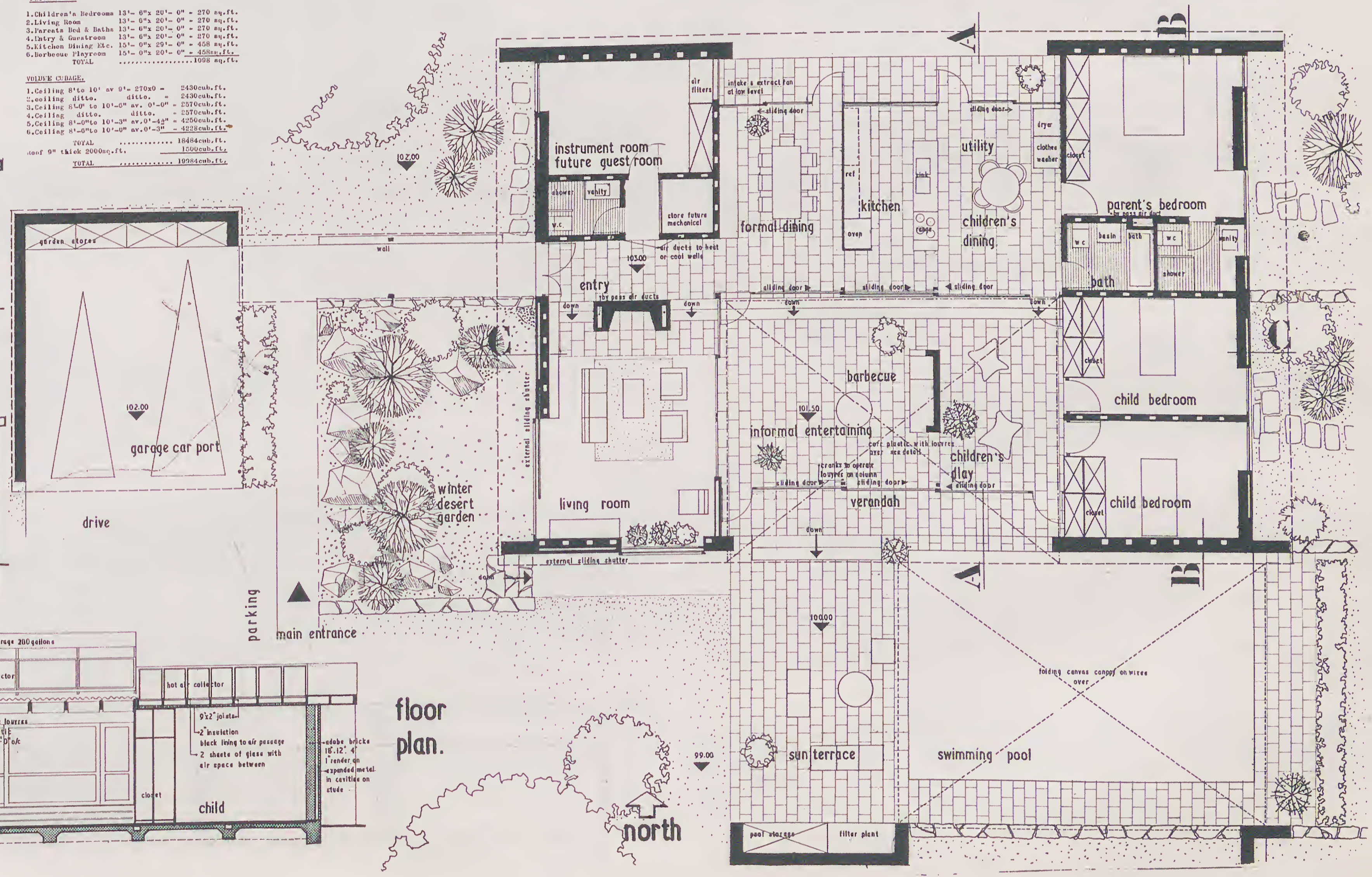
section AA



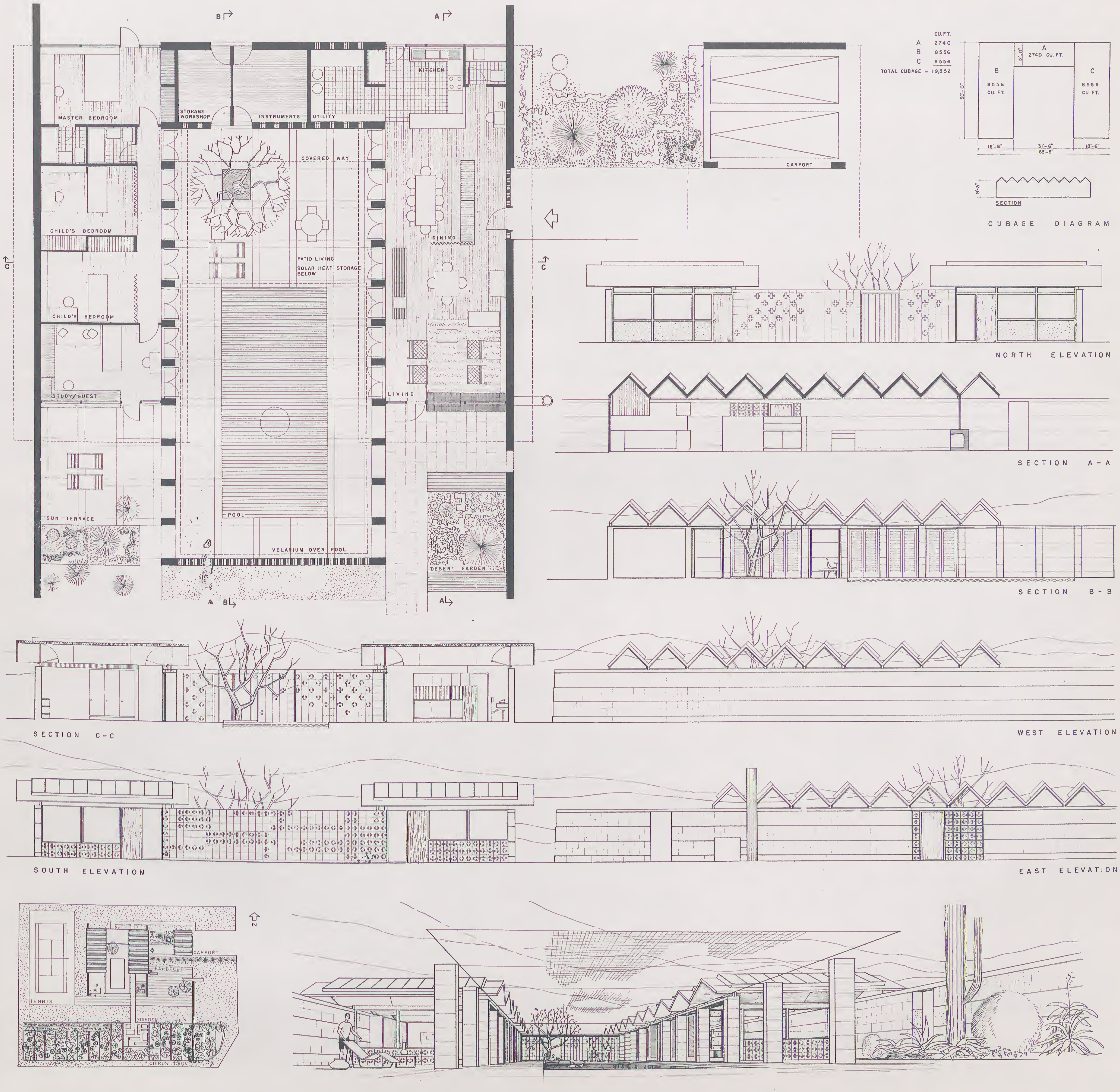
section BB



section CC

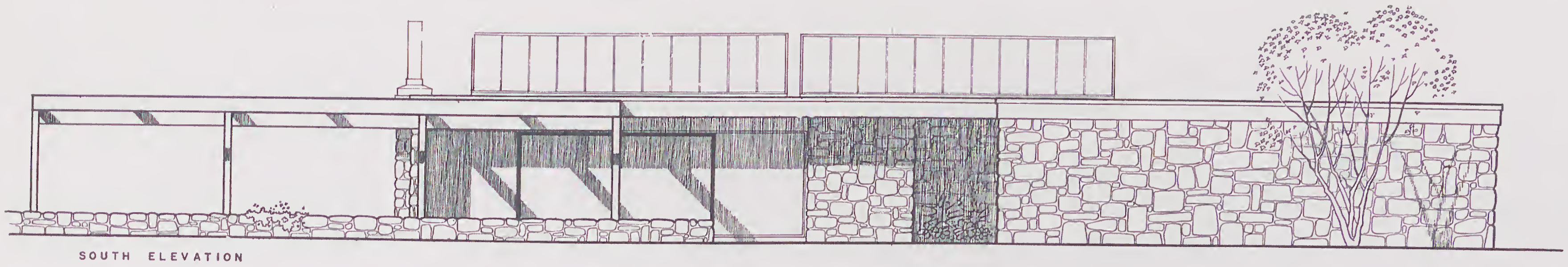


floor plan.

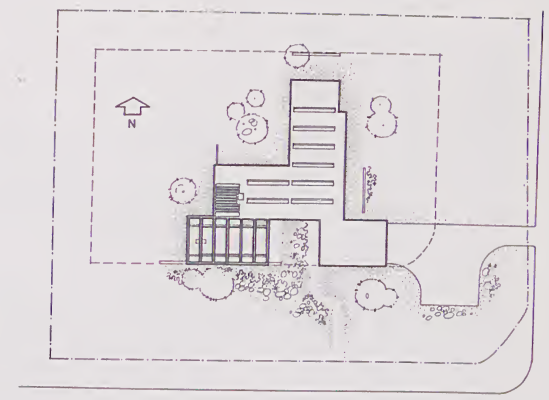

MASTER BEDROOM
STORAGE WORKSHOP
INSTRUMENTS
UTILITY
KITCHEN
COVERED WAY
CHILD'S BEDROOM
CHILD'S BEDROOM
DINING
PATIO LIVING
SOLAR HEAT STORAGE BELOW
STUDY/GUEST
LIVING
SUN TERRACE
POOL
VELARIUM OVER POOL
DESERT GARDEN
CARPORT
CU. FT.
A 2740
B 8556
C 8556
TOTAL CUBAGE = 19,852
2740 CU. FT.
8556 CU. FT.
8556 CU. FT.
SECTION
CUBAGE DIAGRAM
NORTH ELEVATION
SECTION A-A
SECTION B-B
SECTION C-C
WEST ELEVATION
SOUTH ELEVATION
EAST ELEVATION
CARPORT
BARBECUE
TENNIS
GARDEN
CITRUS GROVE
N

PLOT PLAN

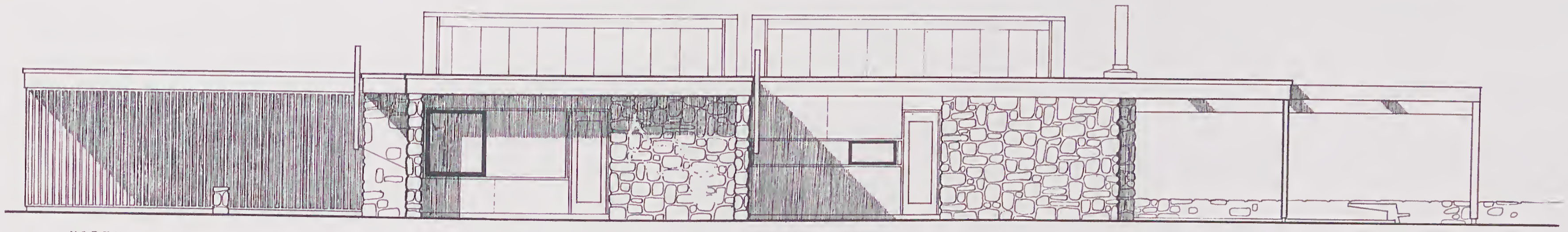
26 JACK FREIDIN, New York, N.Y.



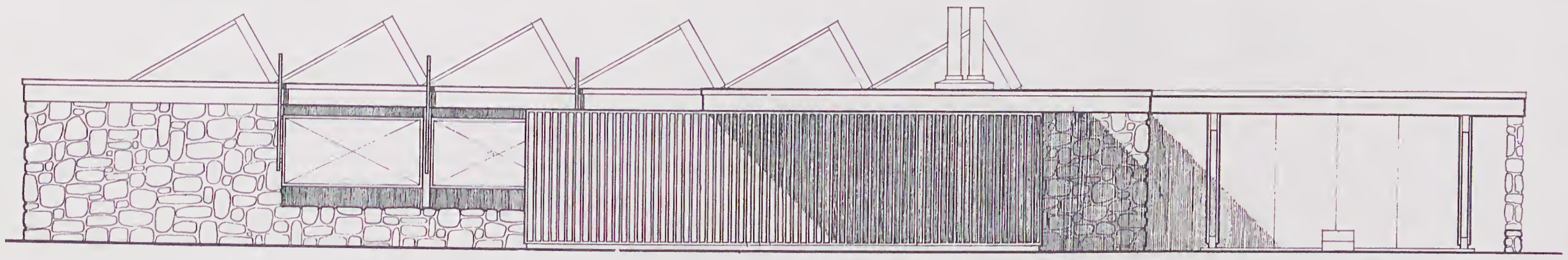
SOUTH ELEVATION



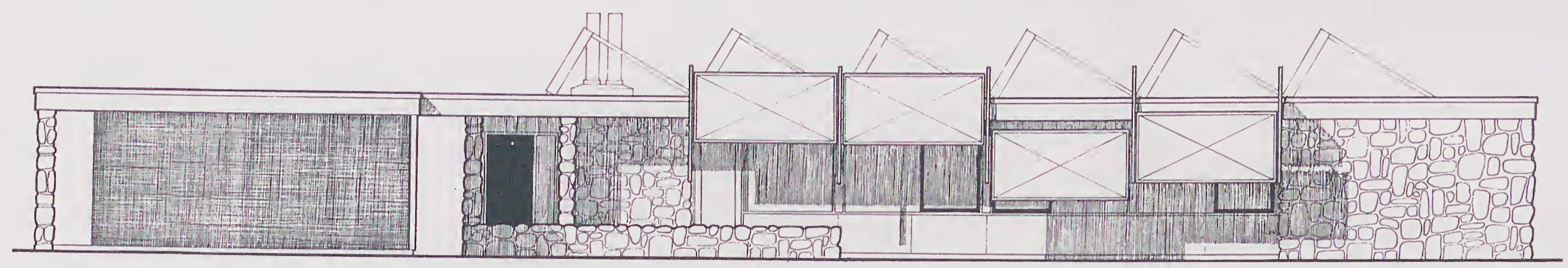
PLOT PLAN



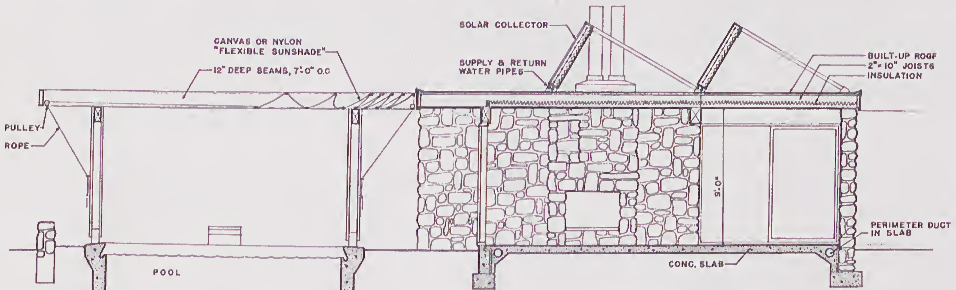
NORTH ELEVATION



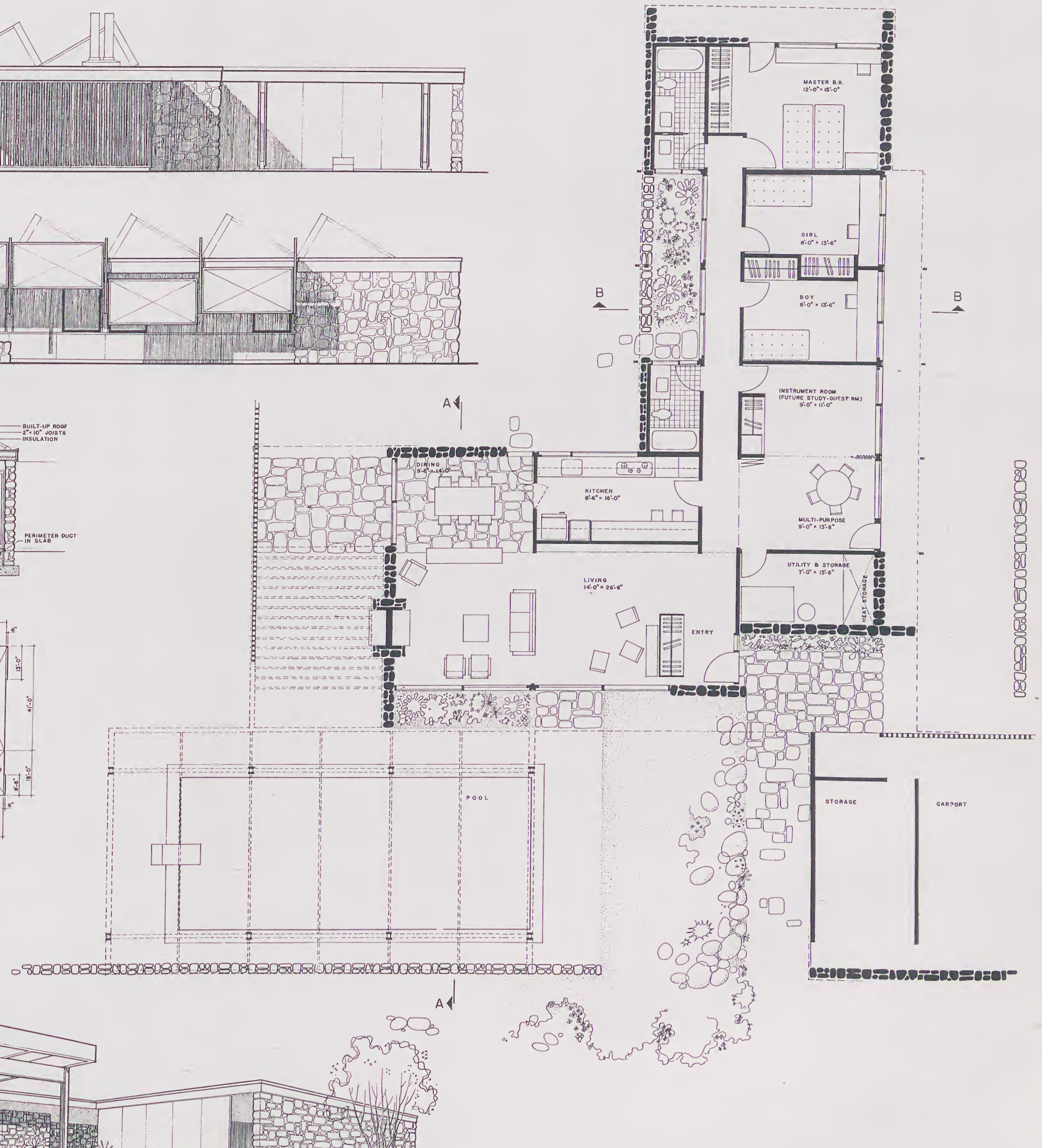
WEST ELEVATION

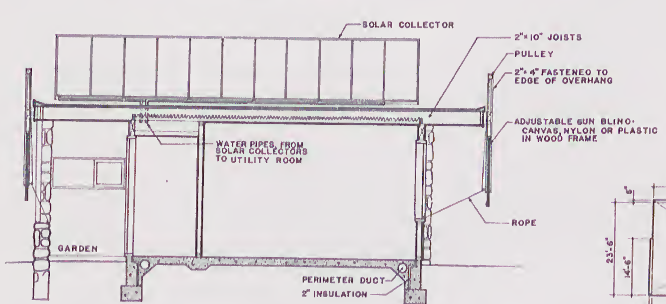


EAST ELEVATION

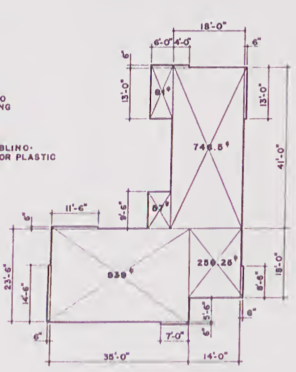


SECTION A-A



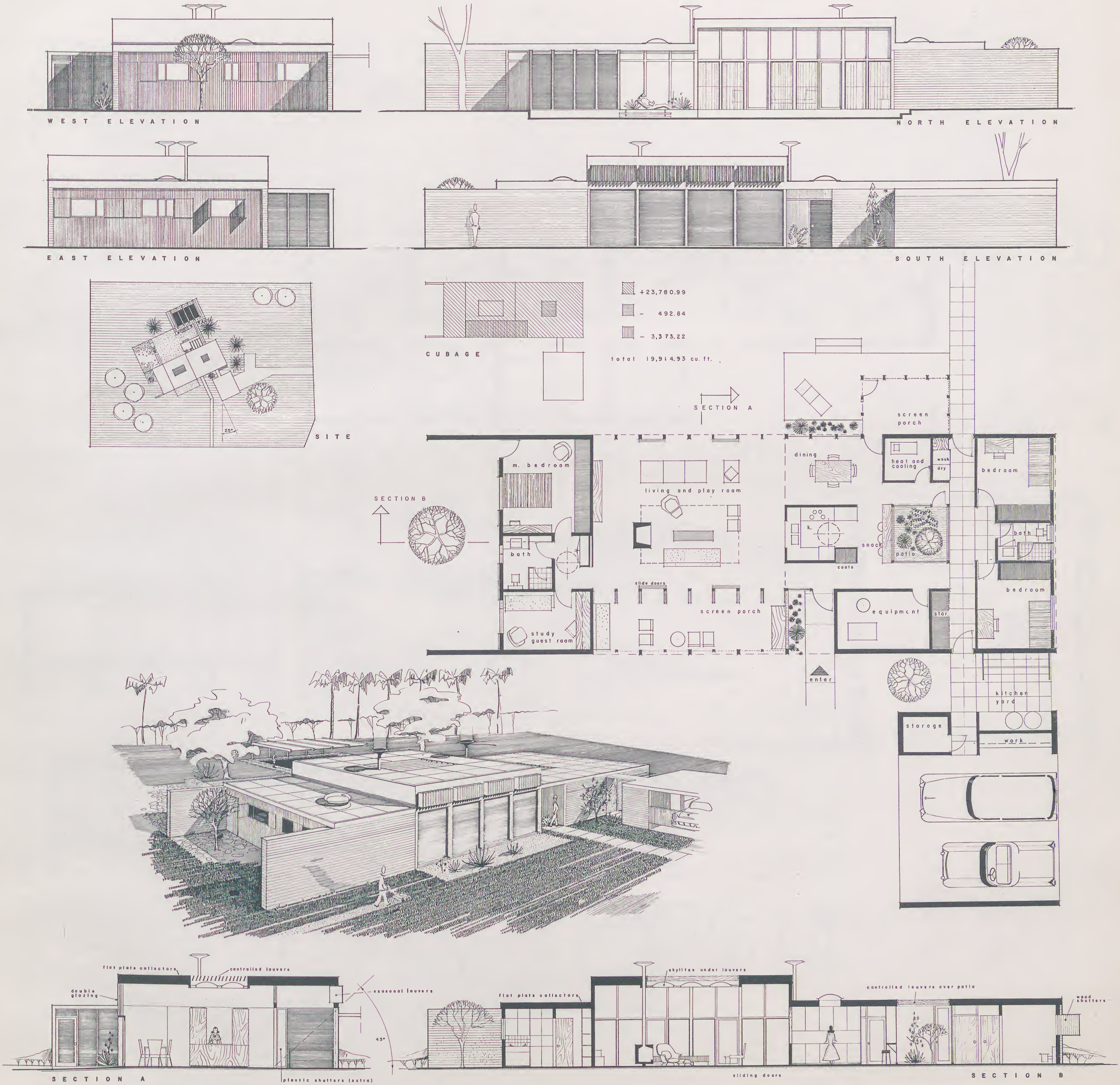


SECTION B-B

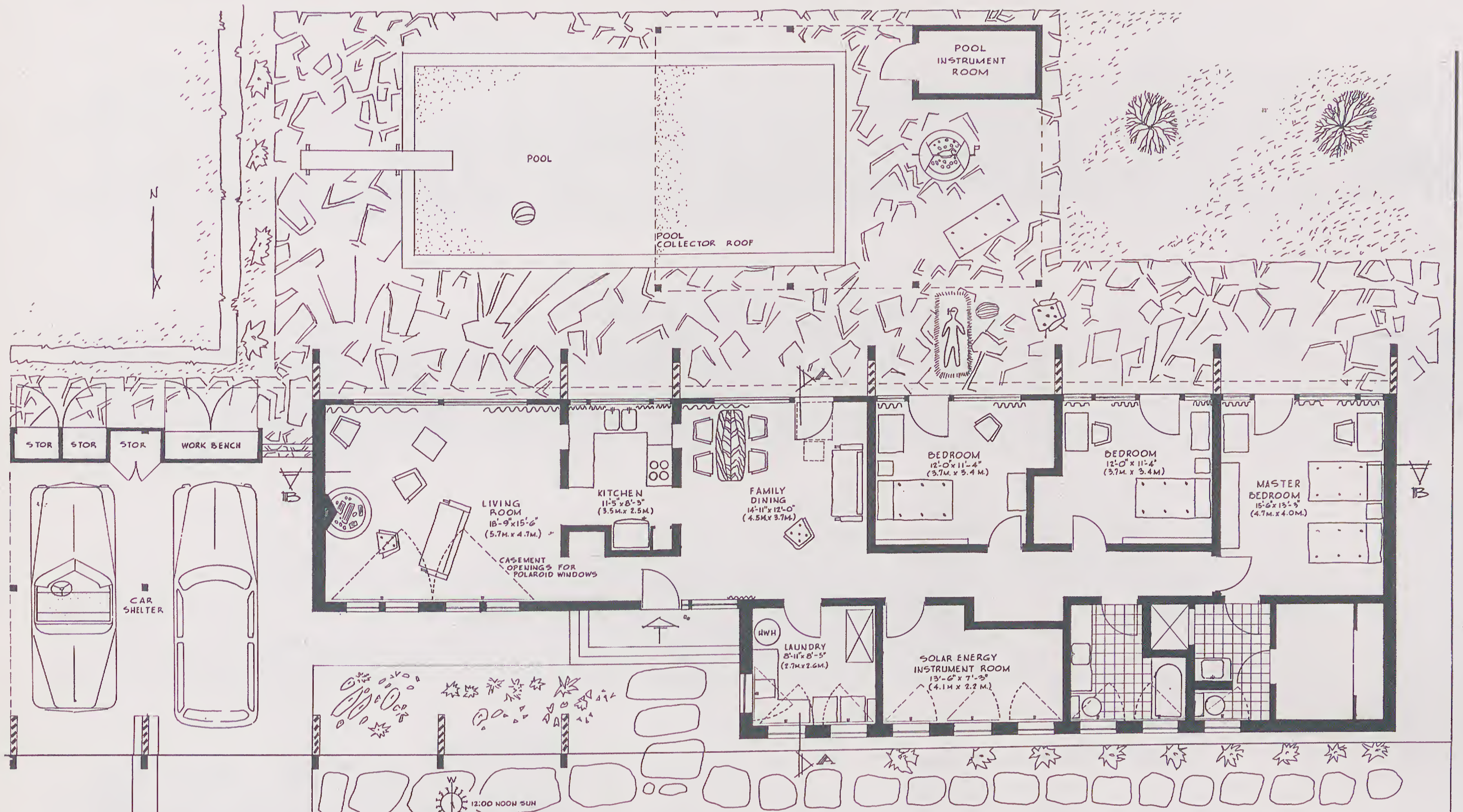


839.00
256.25
746.50
81.00
57.00
1979.75 SQ.FT. TOTAL AREA
x10'
19797.50 CU.FT. TOTAL CUBAGE

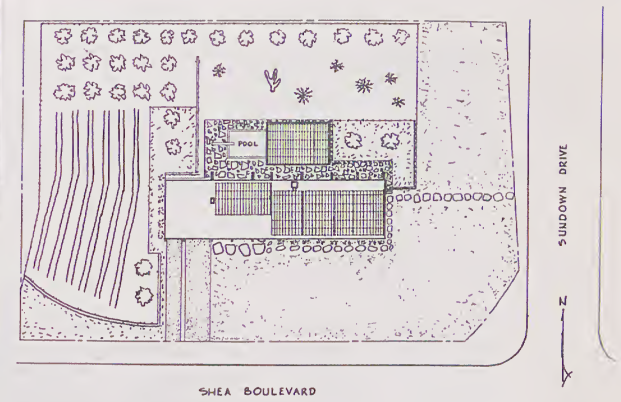
PERSPECTIVE FROM SOUTHWEST


WEST ELEVATION
NORTH ELEVATION
EAST ELEVATION
SOUTH ELEVATION
SITE
25°
CUBAGE
+23,780.99
- 492.84
- 3,373.22
total 19,914.93 cu. ft.
SECTION A
SECTION B
screen porch
dining
heat and cooling
wash
dry
bedroom
m. bedroom
living and play room
k.
snack
patio
bath
slide doors
screen porch
equipment
stor.
bedroom
study guest room
enter
kitchen yard
storage
work
flat plate collectors
controlled louvers
double glazing
seasonal louvers
43°
plastic shutters (extra)
SECTION A
flat plate collectors
skylites under louvers
controlled louvers over patio
wood shutters
sliding doors
SECTION B

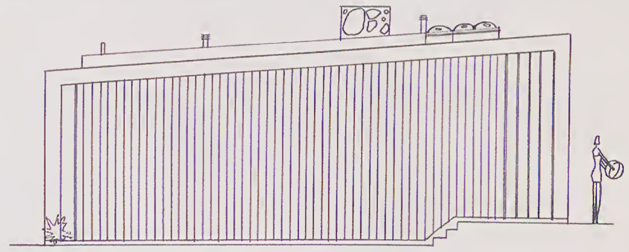
JOHN PALMER HARDWIG, Chicago, Ill.



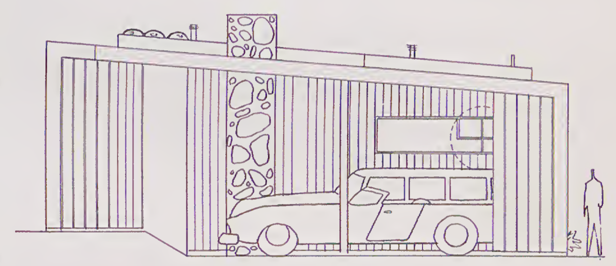
FLOOR PLAN



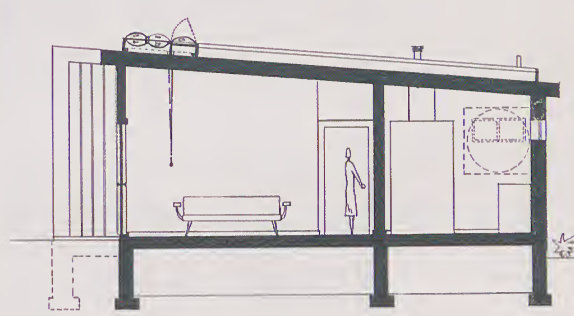
PLOT PLAN



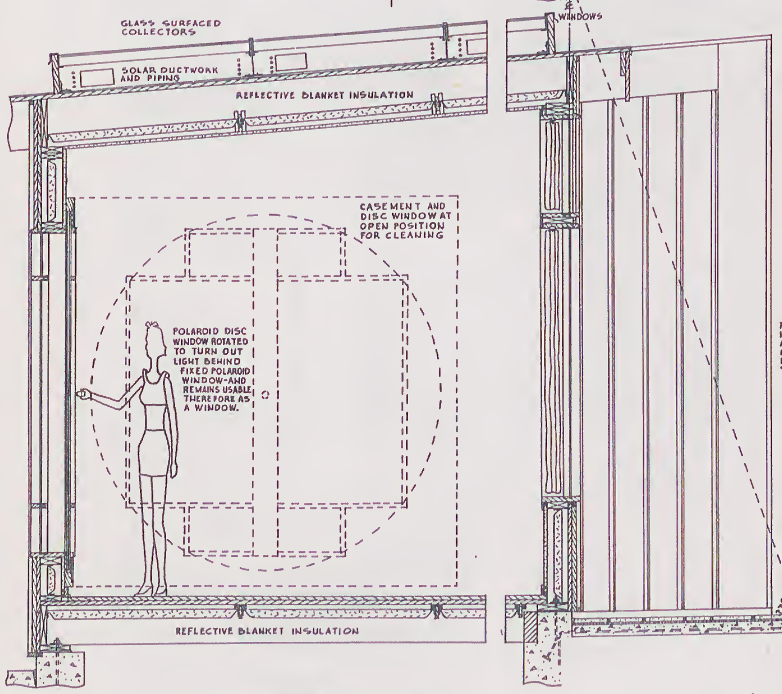
EAST ELEVATION



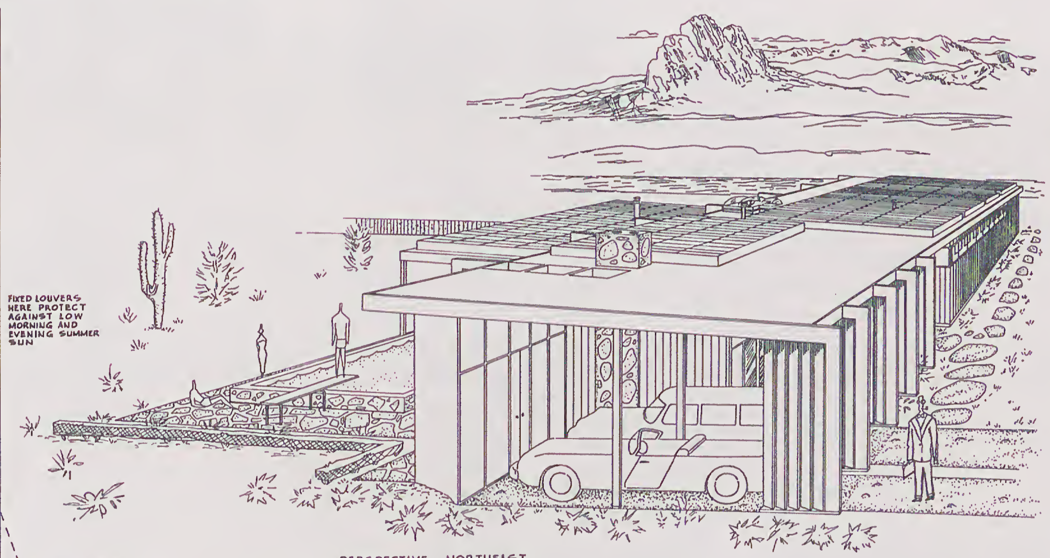
WEST ELEVATION



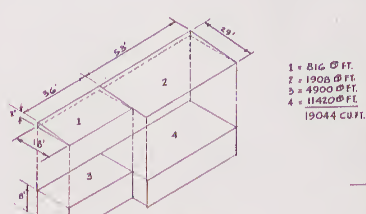
SECTION A-A



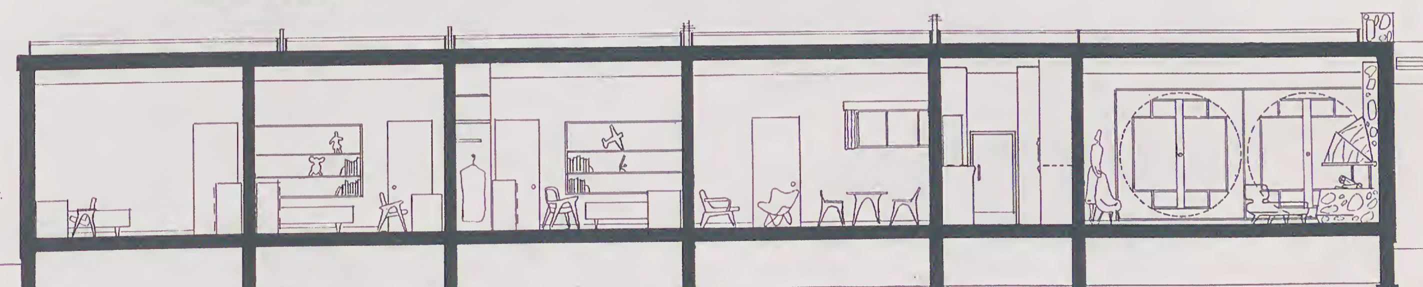
SECTION THRU LIVING ROOM WINDOWS



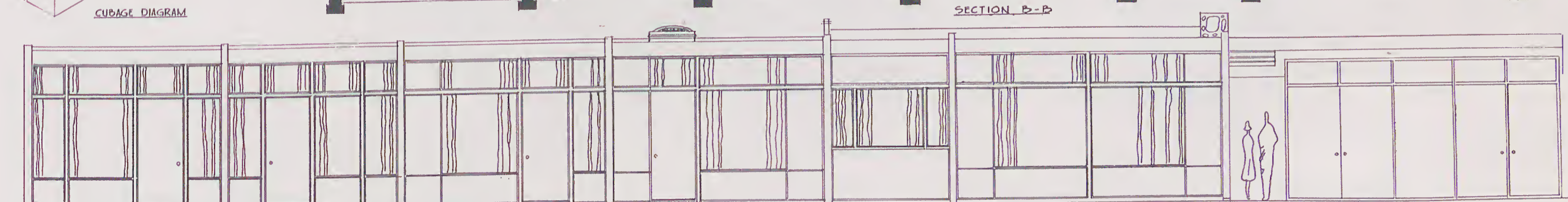
PERSPECTIVE NORTHEAST



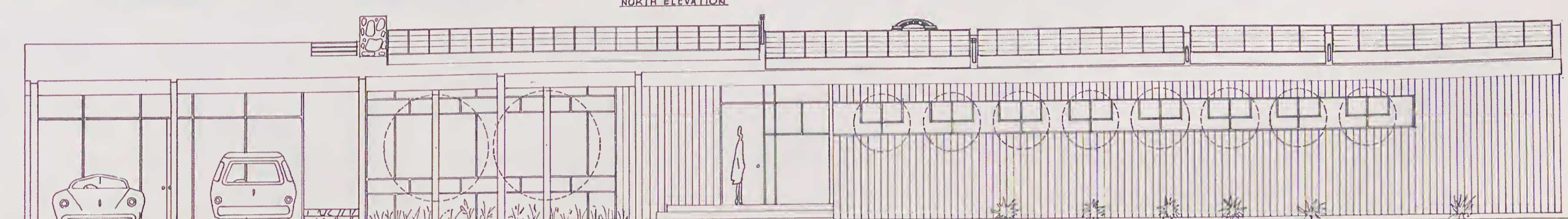
CUBAGE DIAGRAM



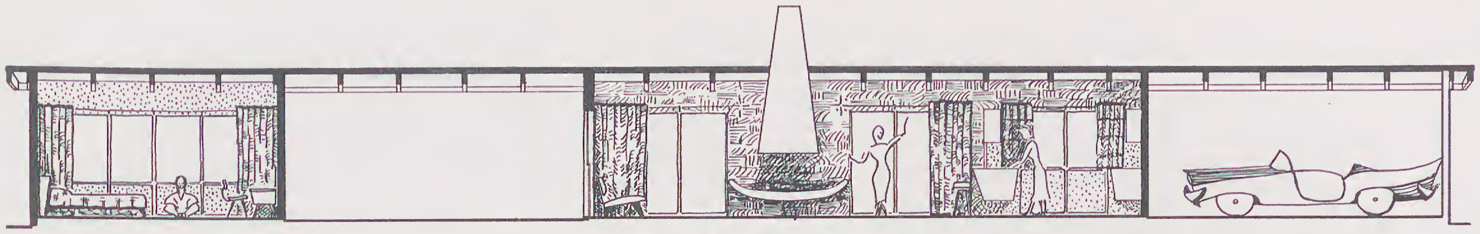
SECTION B-B



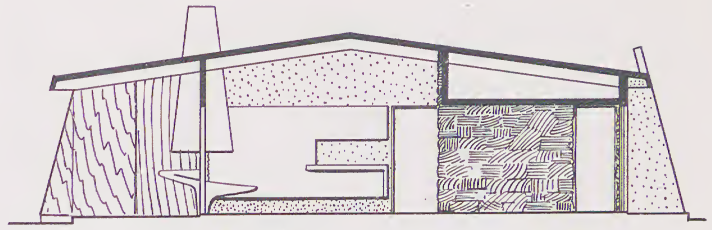
NORTH ELEVATION



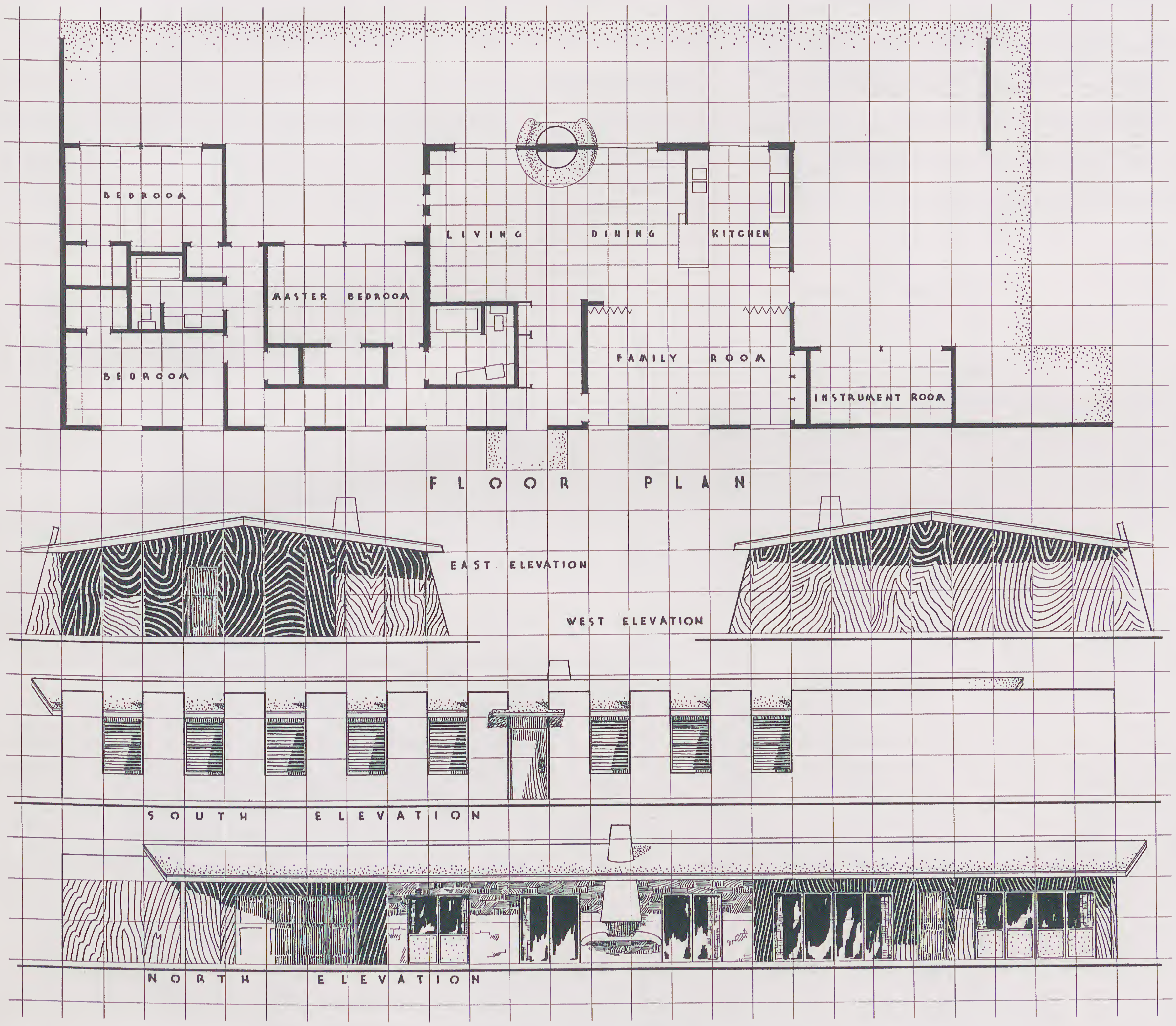
SOUTH ELEVATION



LONGITUDINAL SECTION



LATERAL SECTION



FLOOR PLAN

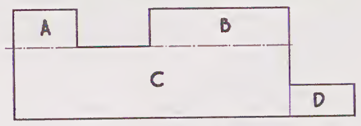
EAST ELEVATION

WEST ELEVATION

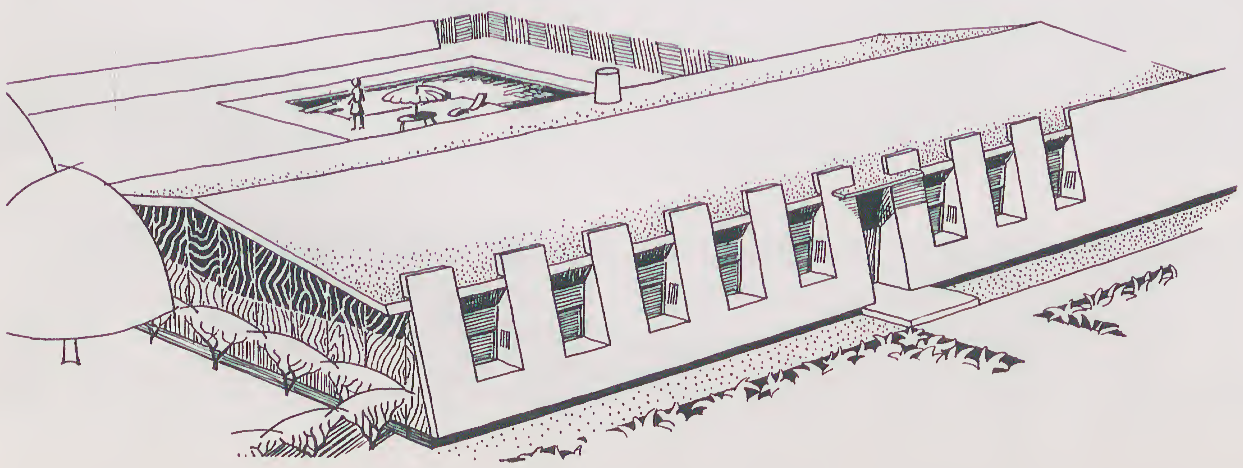
SOUTH ELEVATION

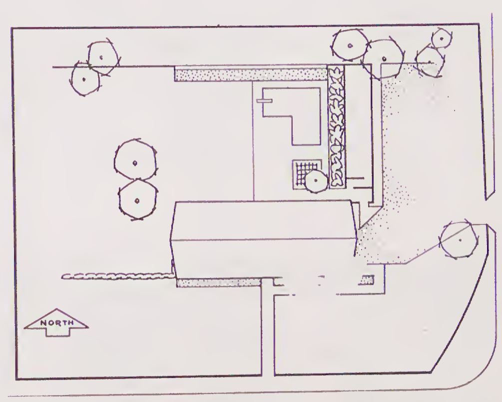
NORTH ELEVATION

SPACE	WIDTH •	LENGTH =	AREA •	AV. HGT. =	CUBAGE
A	10 •	16 =	160 •	11 =	1760
B	10 •	36 =	360 •	11 =	3960
C	18 •	72 =	1296 •	10 =	12960
D	8 •	16 =	128 •	10 =	1280
TOTAL AREA			1944	CUBAGE	19960



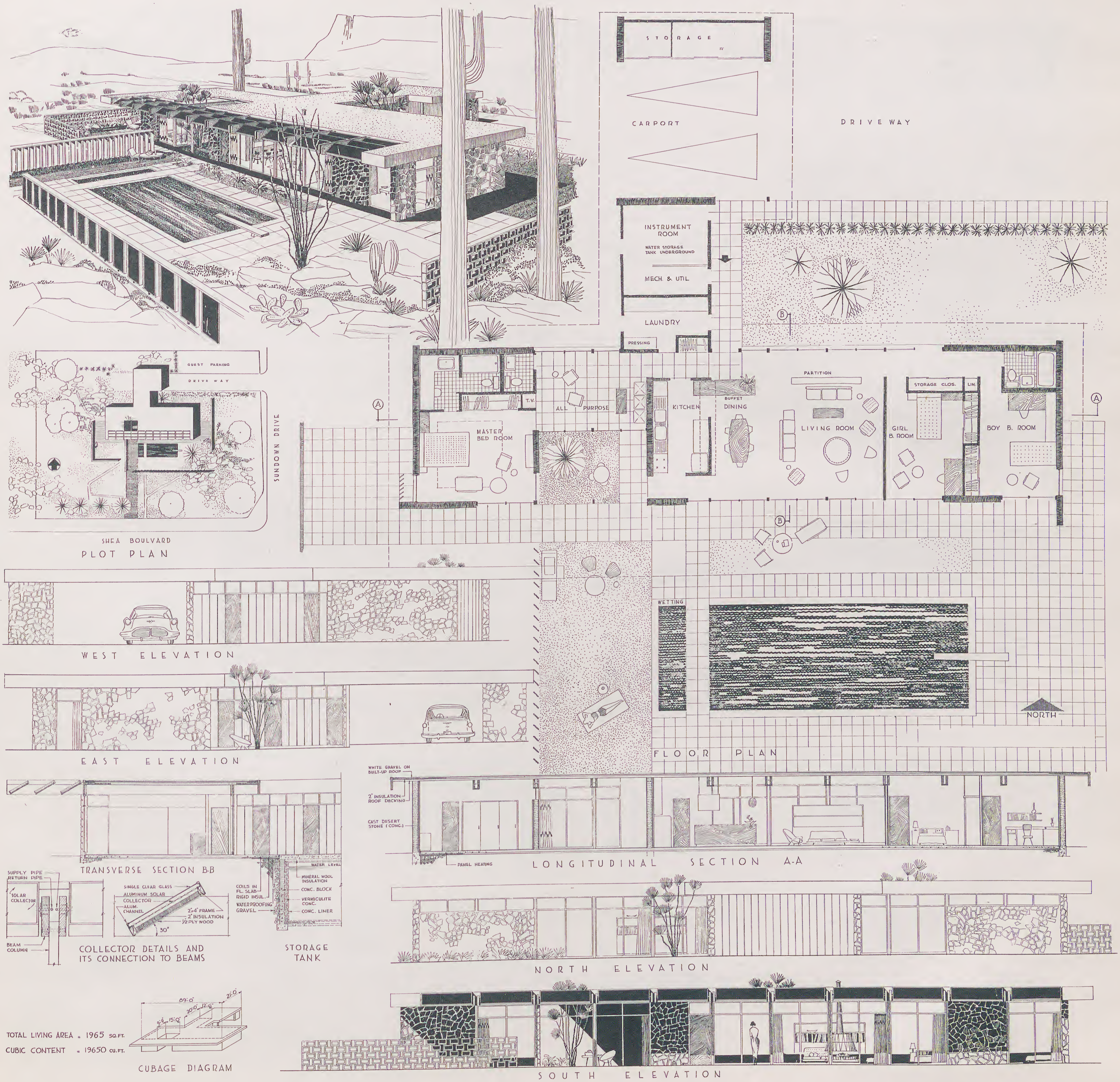
CUBAGE DIAGRAM

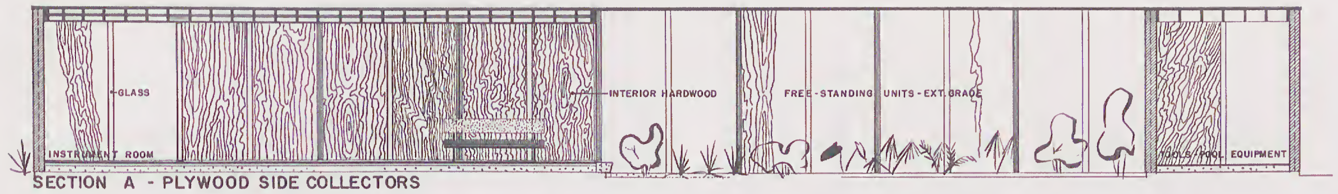




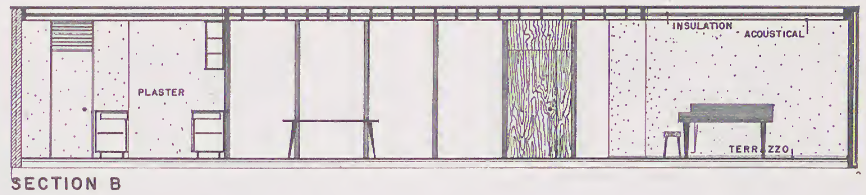
PLOT PLAN

30 MARVIN HATAMI, Denver, Colo.

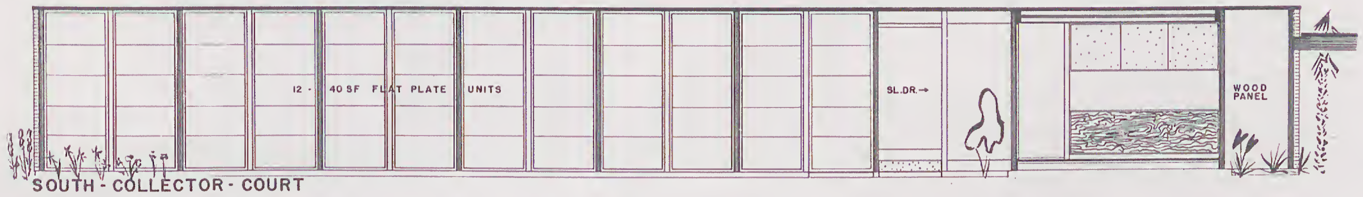




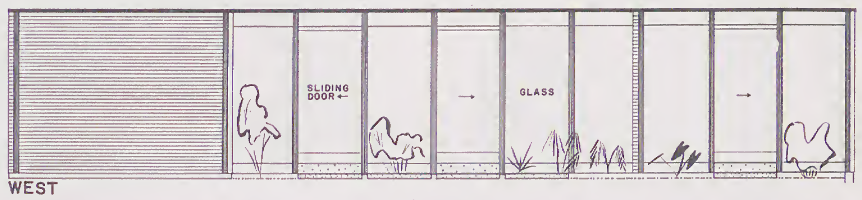
SECTION A - PLYWOOD SIDE COLLECTORS



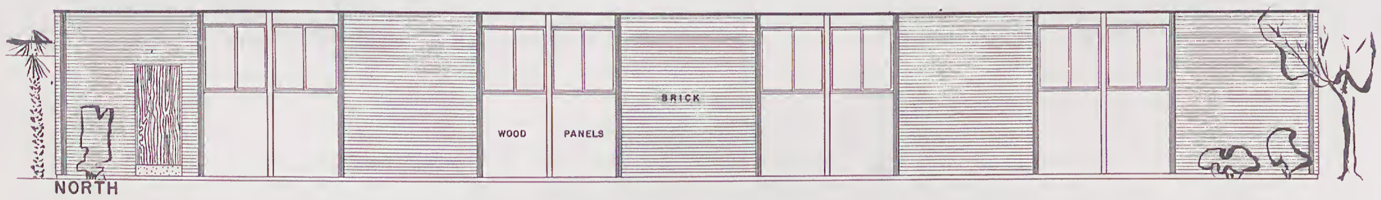
SECTION B



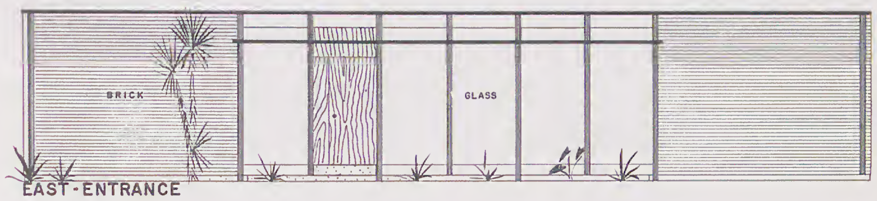
SOUTH - COLLECTOR - COURT



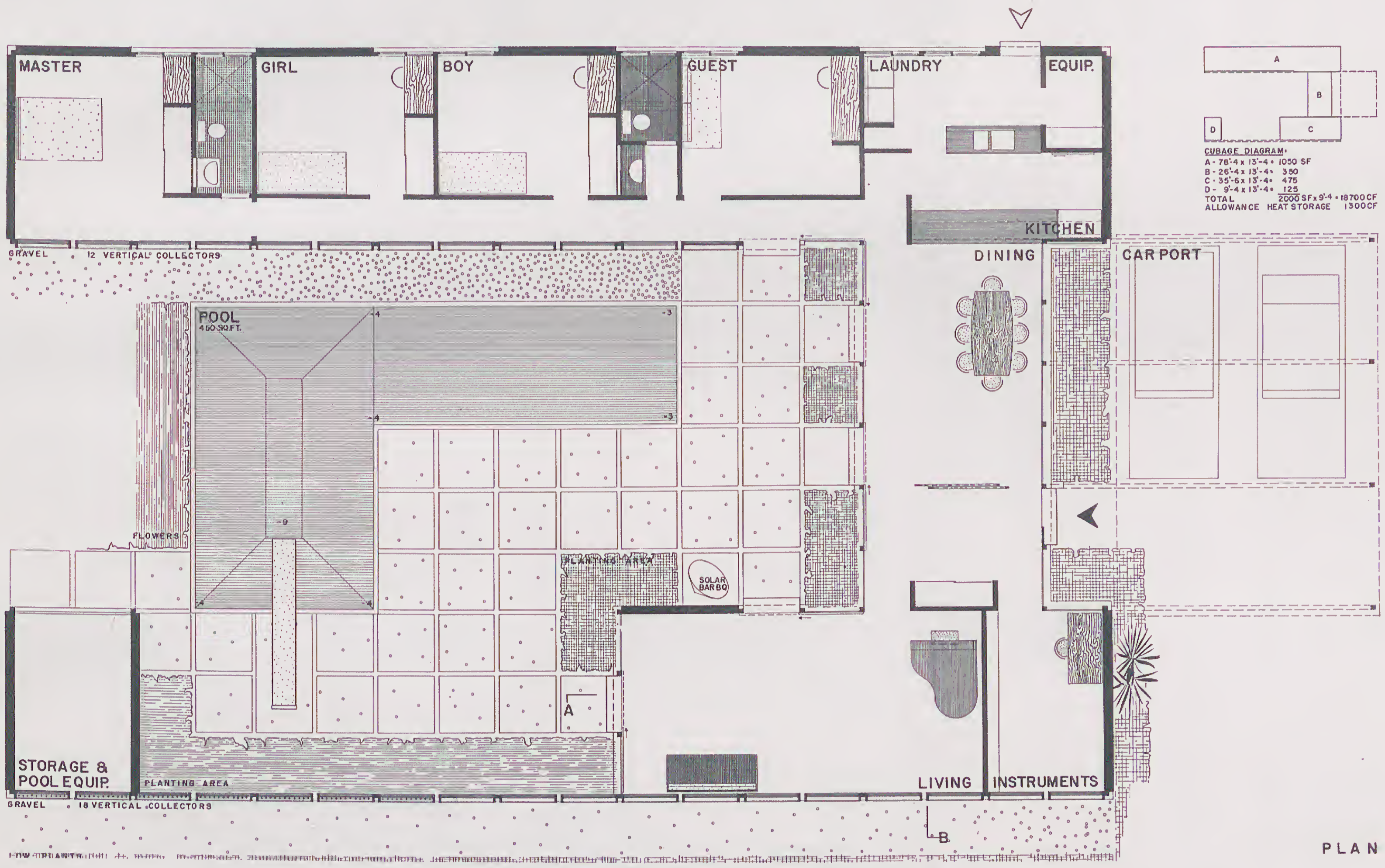
WEST



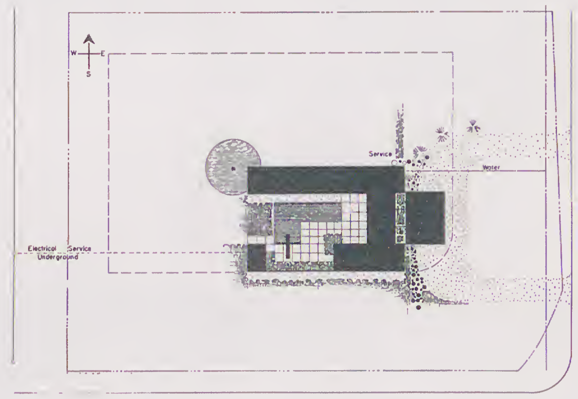
NORTH

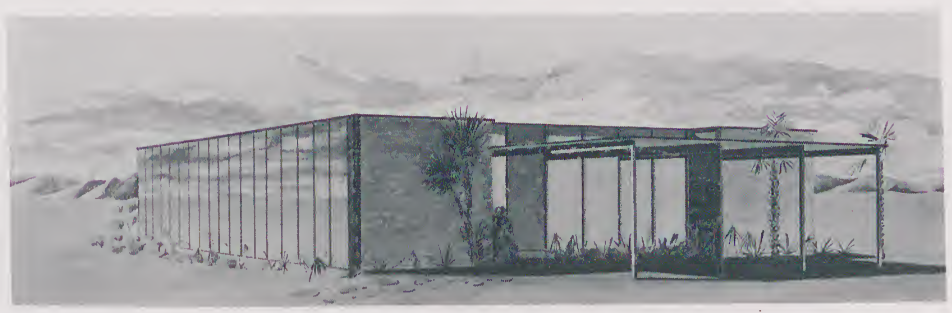


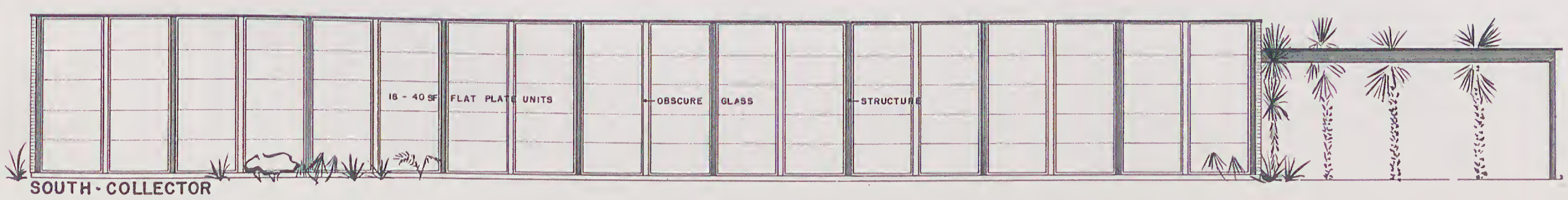
EAST - ENTRANCE



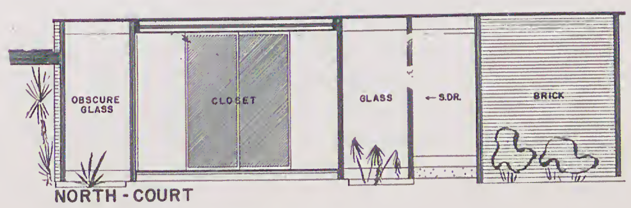
PLAN





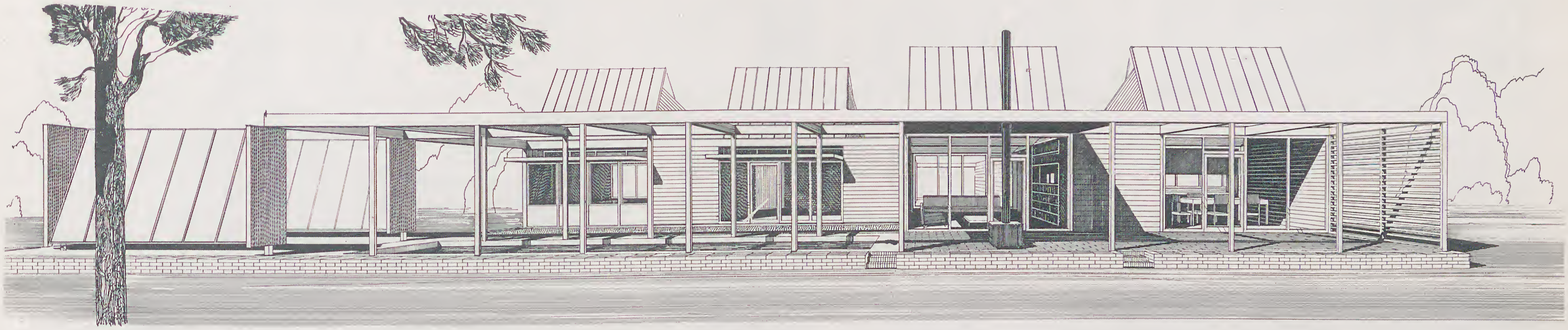


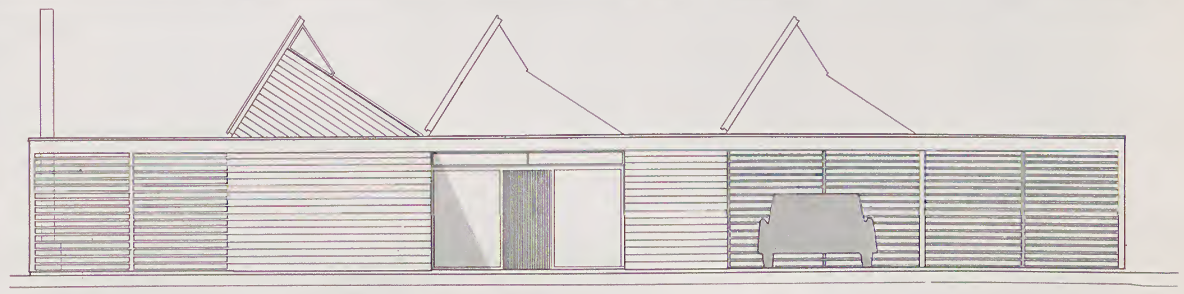
SOUTH - COLLECTOR

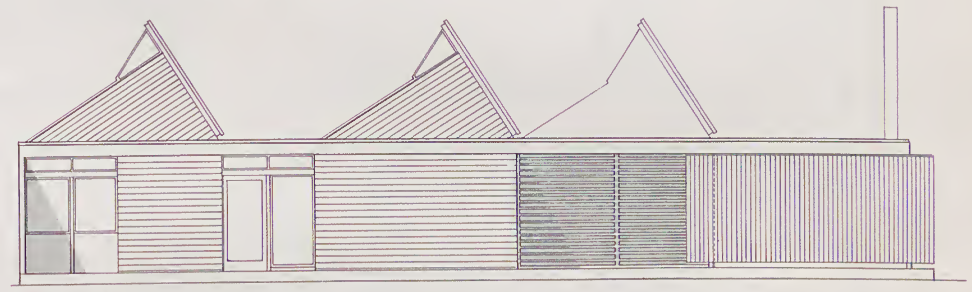


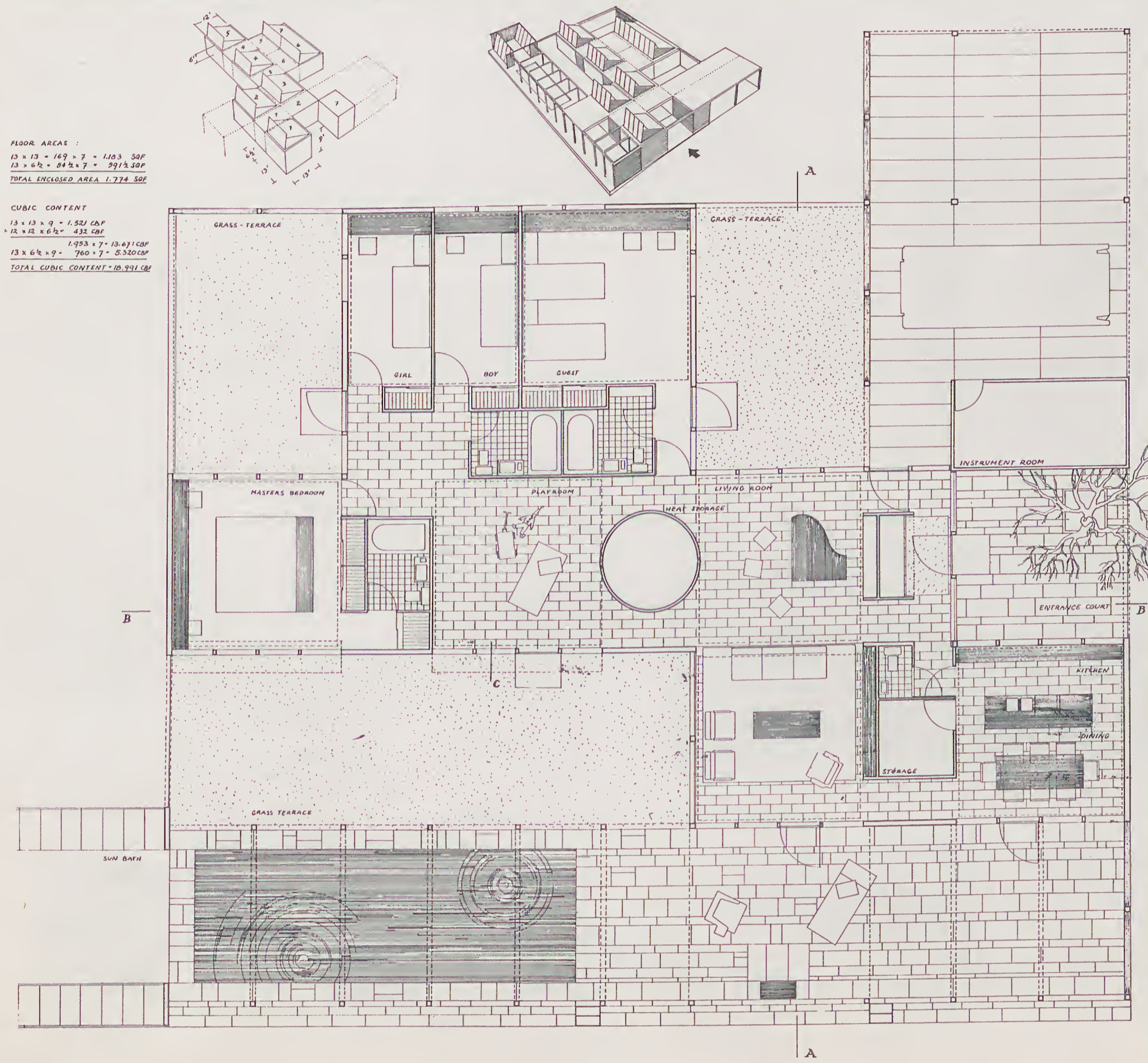
NORTH - COURT

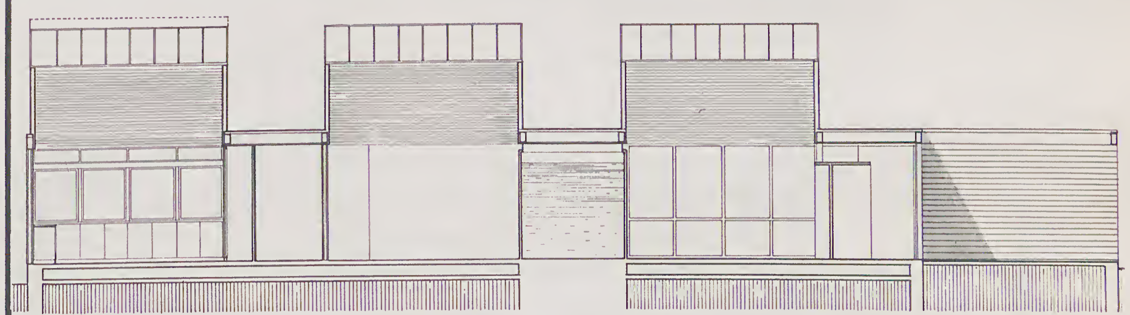
WILHELM HOLZBAUER, Winnipeg, Canada

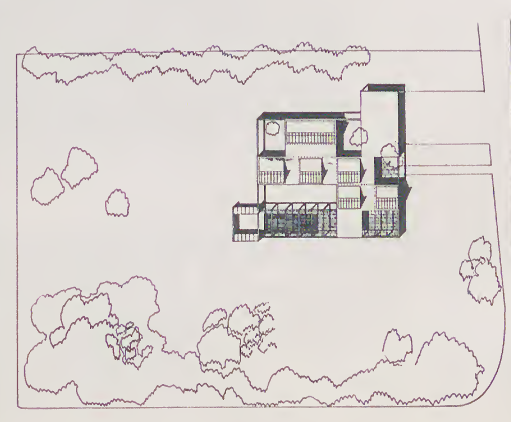










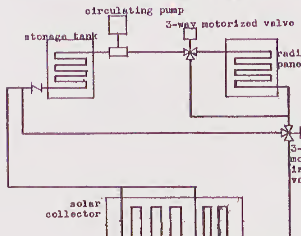


Collector Area = $\frac{750{,}000}{.6 \times 2000}$ = 630'^{2}

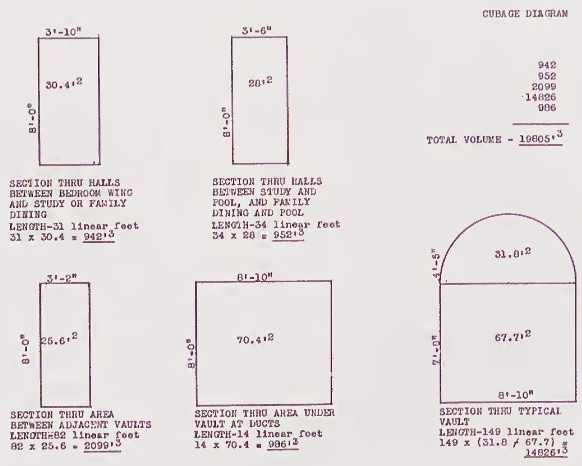
Domestic Water Heating Collector Area = 120'^{2}

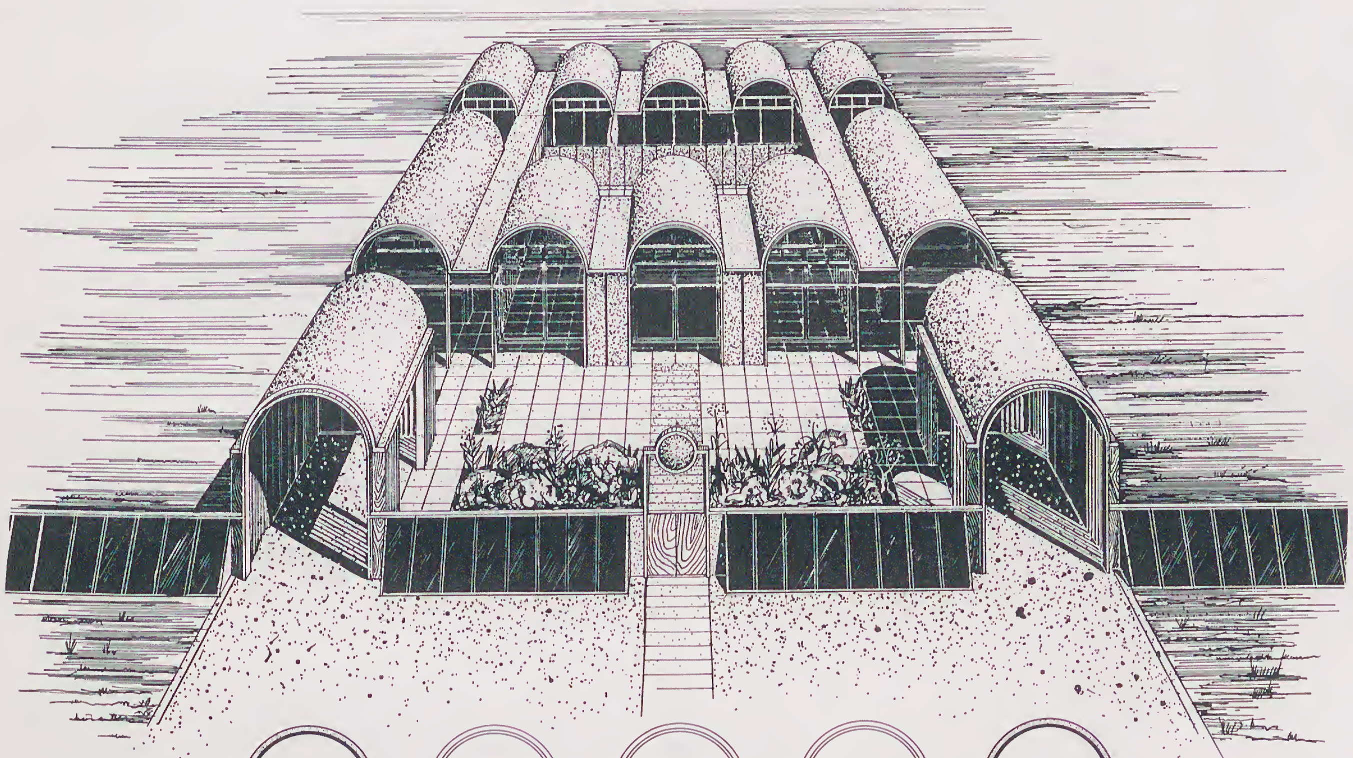
Swimming Pool Collector Area = 300'^{2}

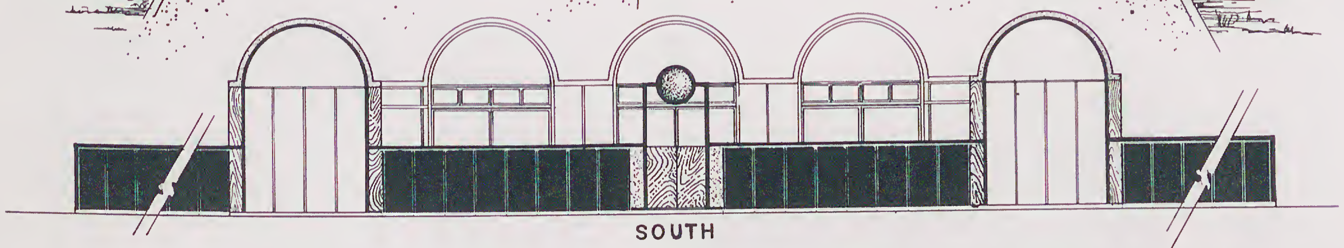
TOTAL AREA = 1050'^{2}



1. Storage to radiant panel to collector to storage
2. Storage to collector to storage
3. Storage to panel to storage

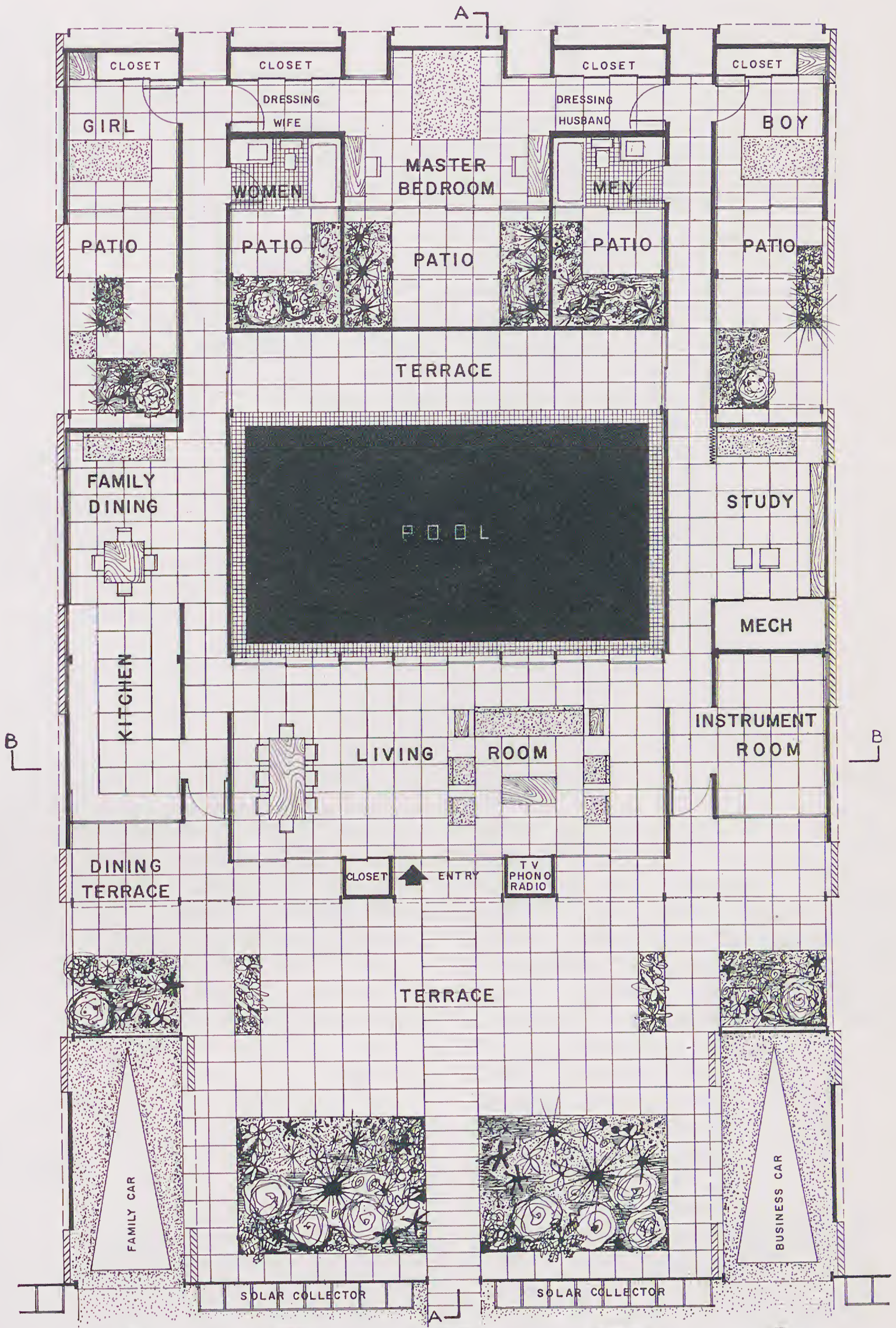


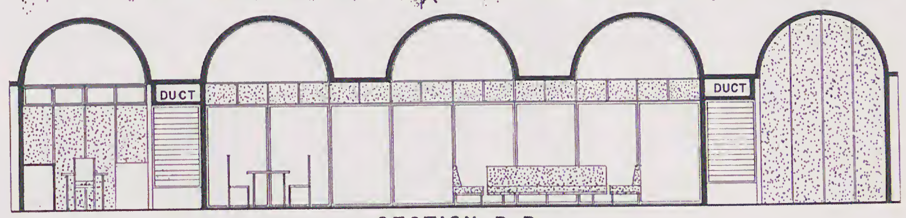




SOUTH

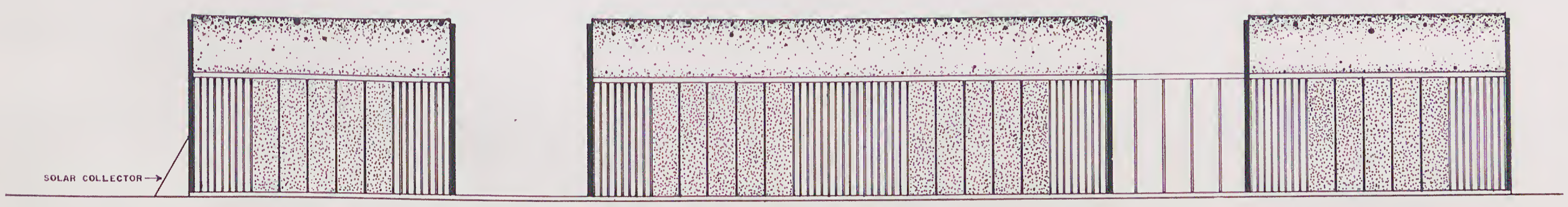
NORTH



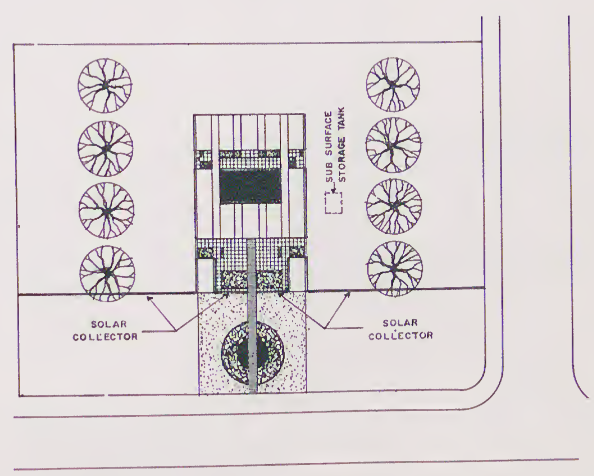


SECTION B-B

SECTION A-A

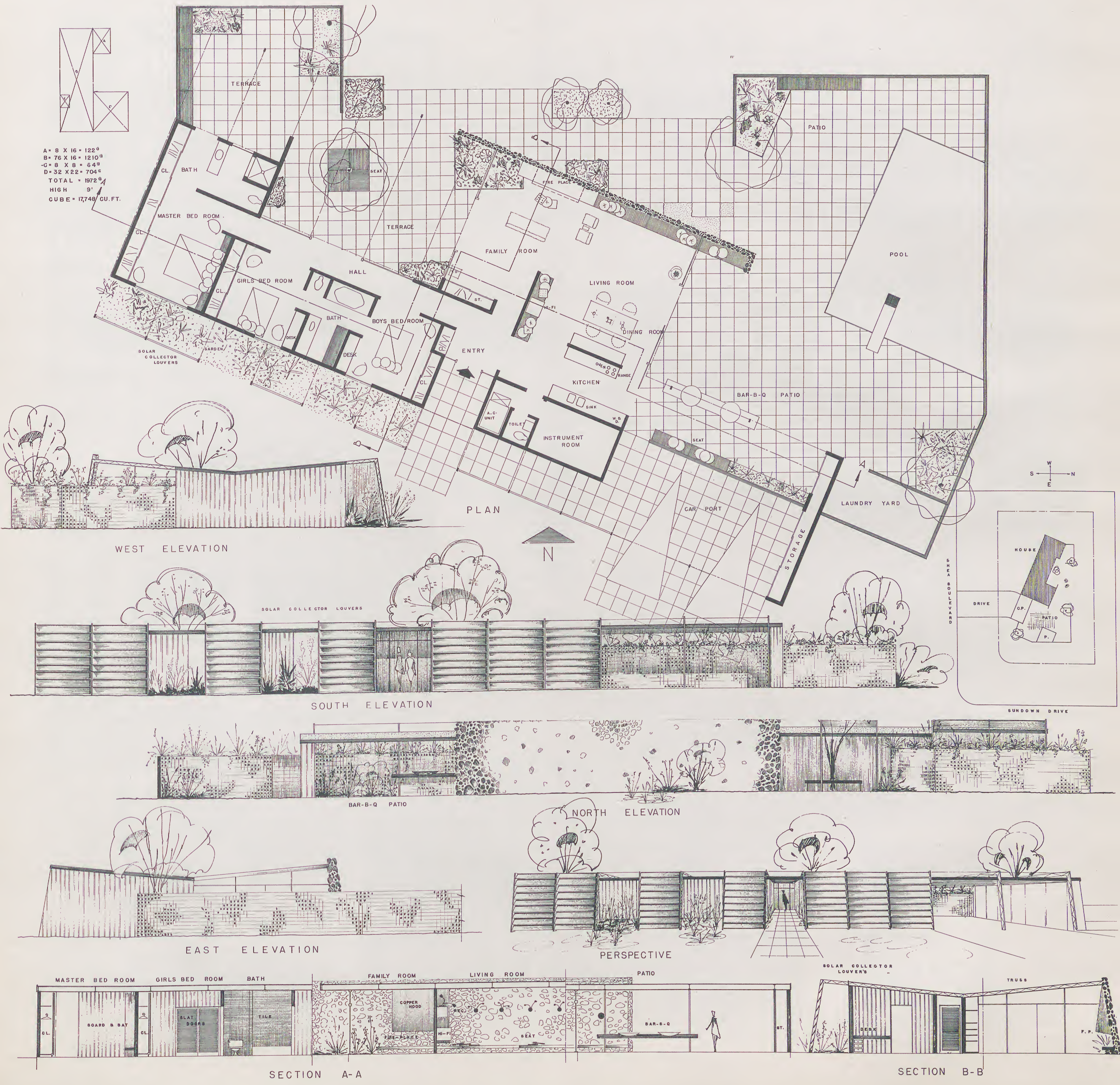


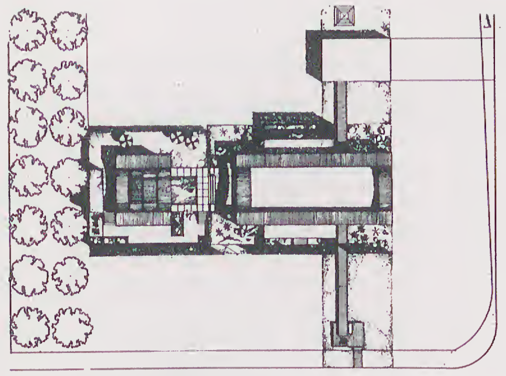
EAST ELEVATION (WEST SAME OPPOSITE HAND)

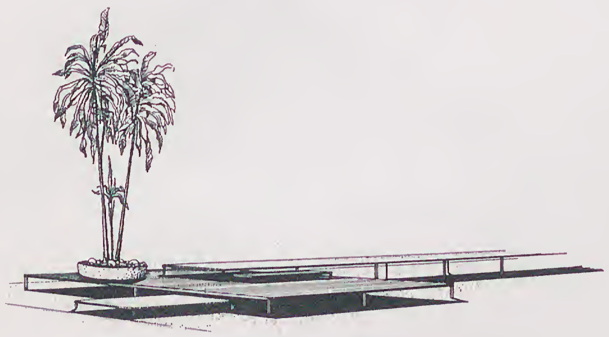


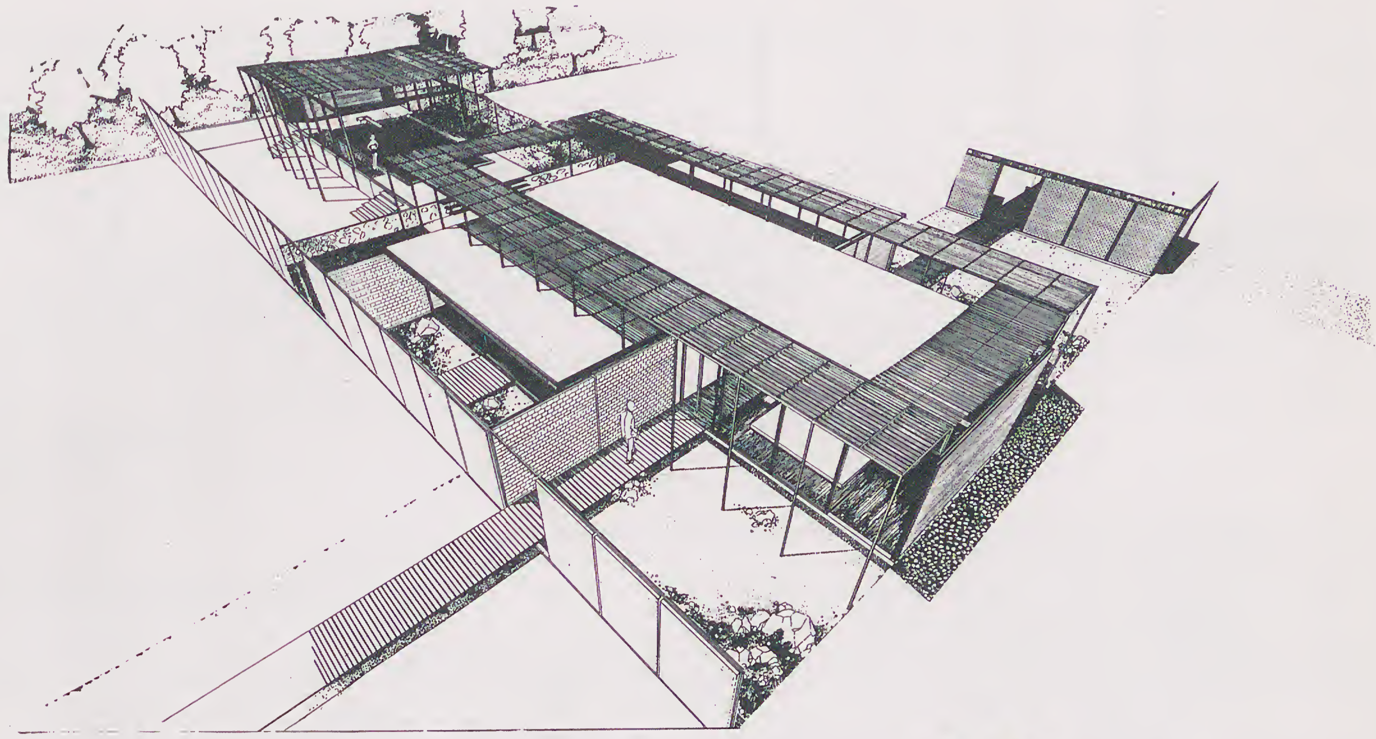
PLOT PLAN

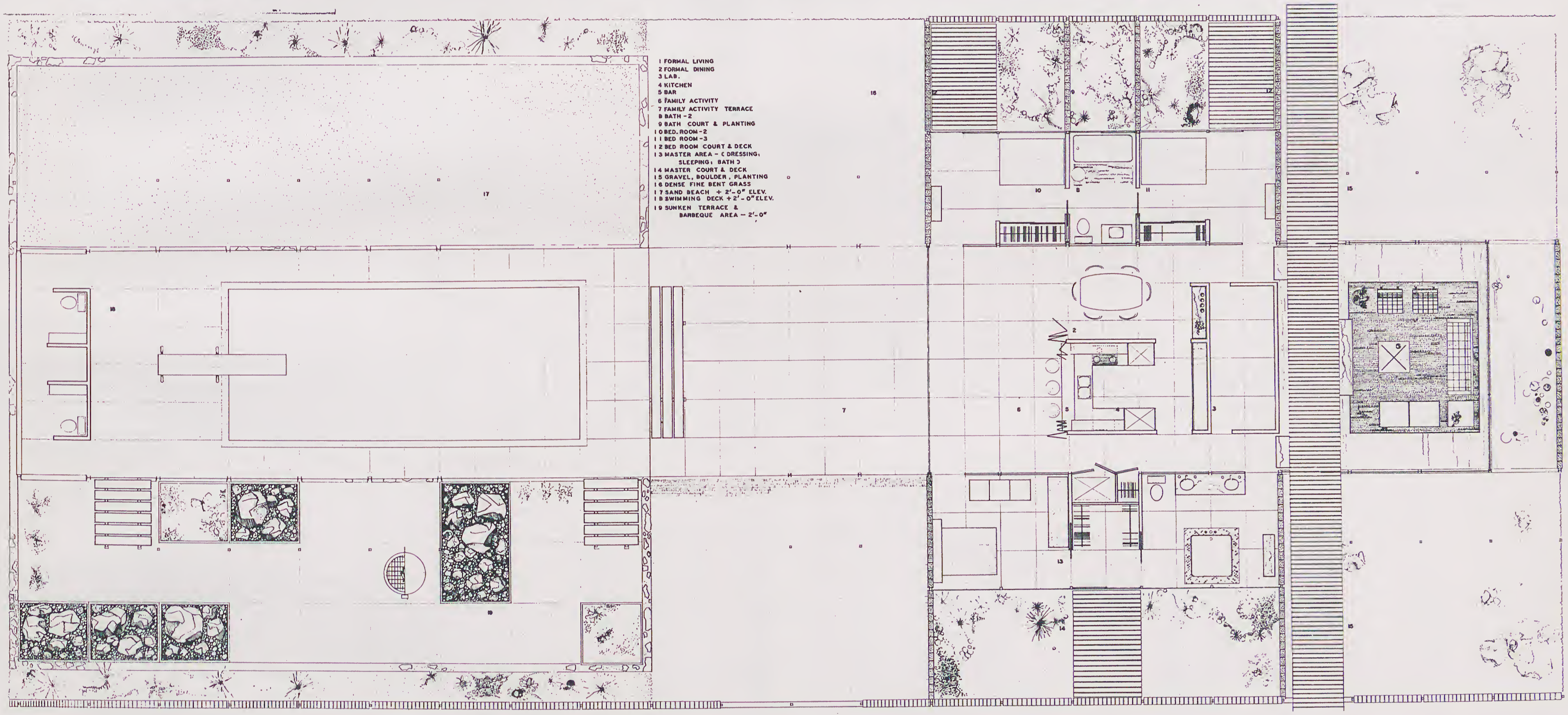
34 DAVID HUNT, Phoenix, Ariz.

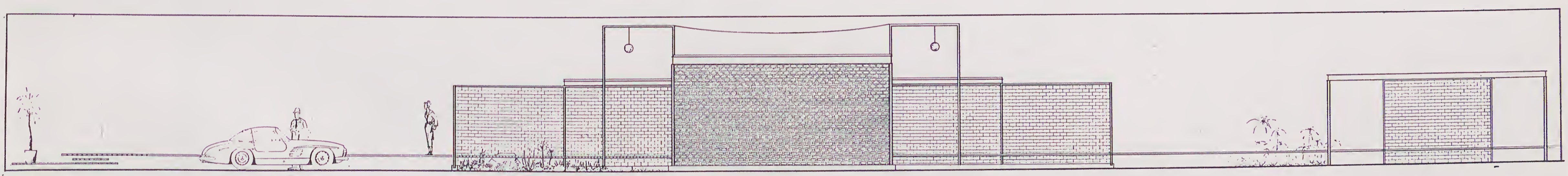


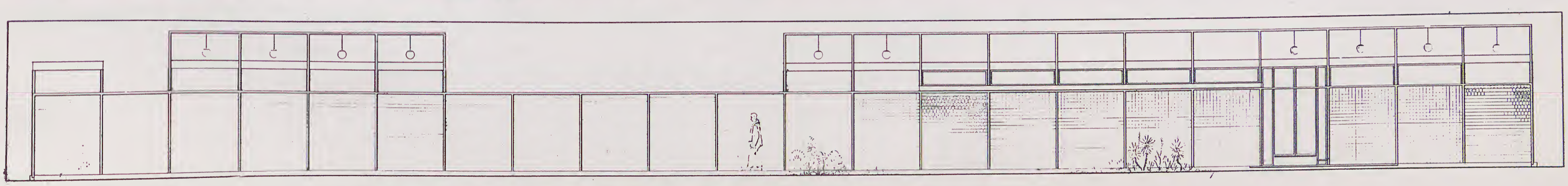




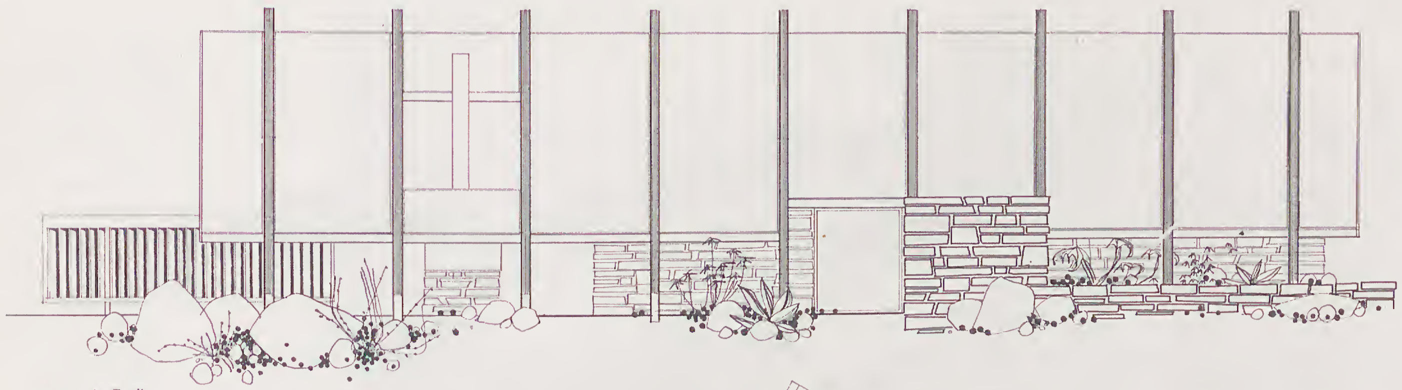



1 FORMAL LIVING
2 FORMAL DINING
3 LAB.
4 KITCHEN
5 BAR
6 FAMILY ACTIVITY
7 FAMILY ACTIVITY TERRACE
8 BATH - 2
9 BATH COURT & PLANTING
10 BED. ROOM - 2
11 BED ROOM - 3
12 BED ROOM COURT & DECK
13 MASTER AREA - (DRESSING, SLEEPING, BATH)
14 MASTER COURT & DECK
15 GRAVEL, BOULDER, PLANTING
16 DENSE FINE BENT GRASS
17 SAND BEACH + 2'-0" ELEV.
18 SWIMMING DECK + 2'-0" ELEV.
19 SUNKEN TERRACE & BARBEQUE AREA - 2'-0"

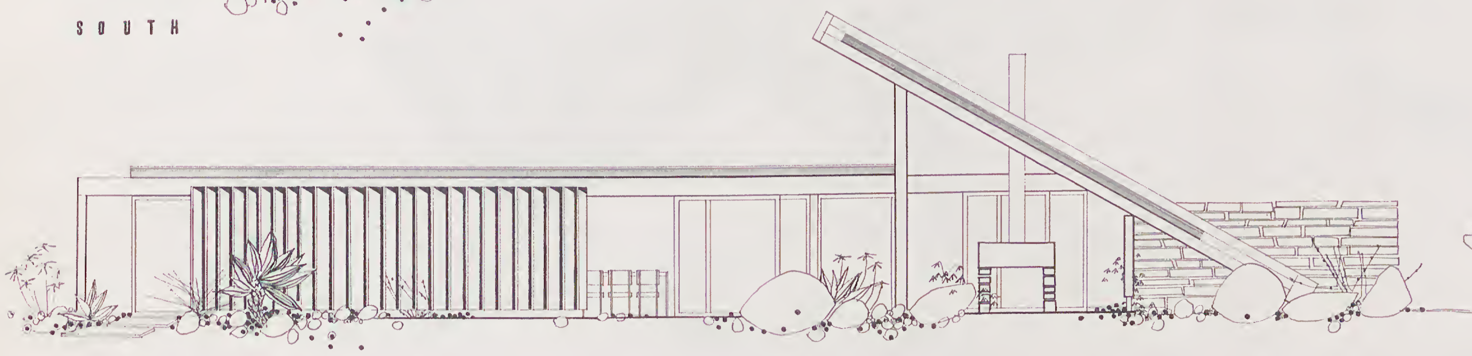




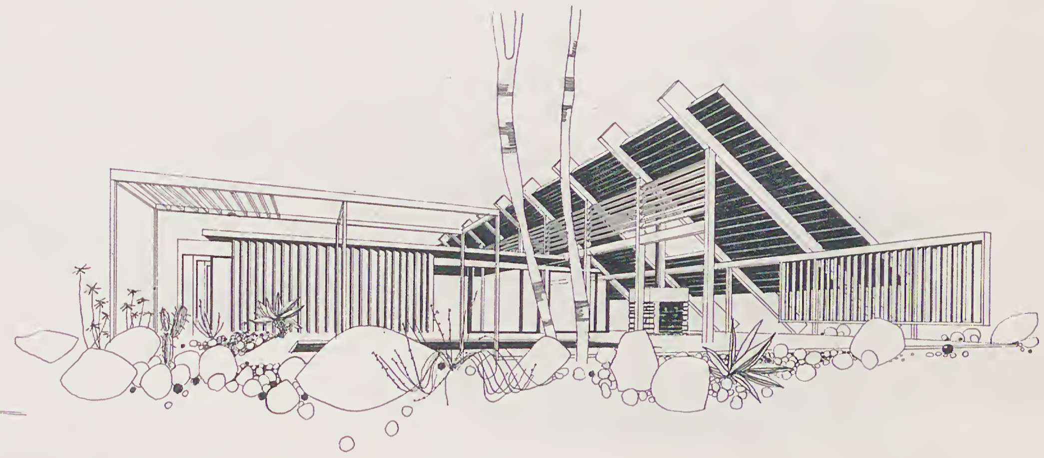
36 ROY LATHAM and G. M. T. G. SIMPSON, Harlow, Essex, England

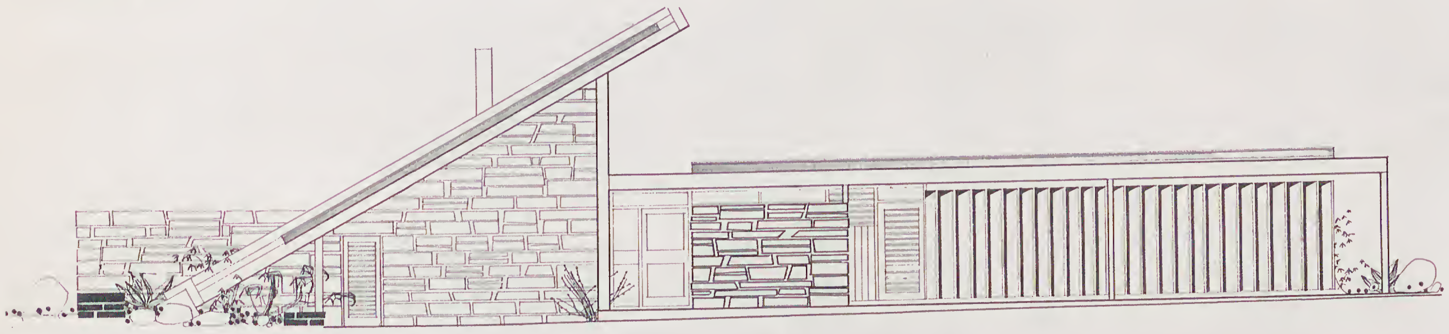


SOUTH

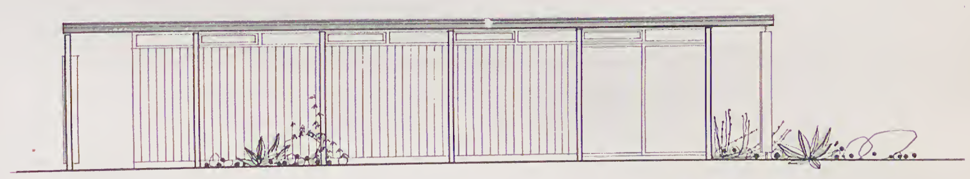


WEST

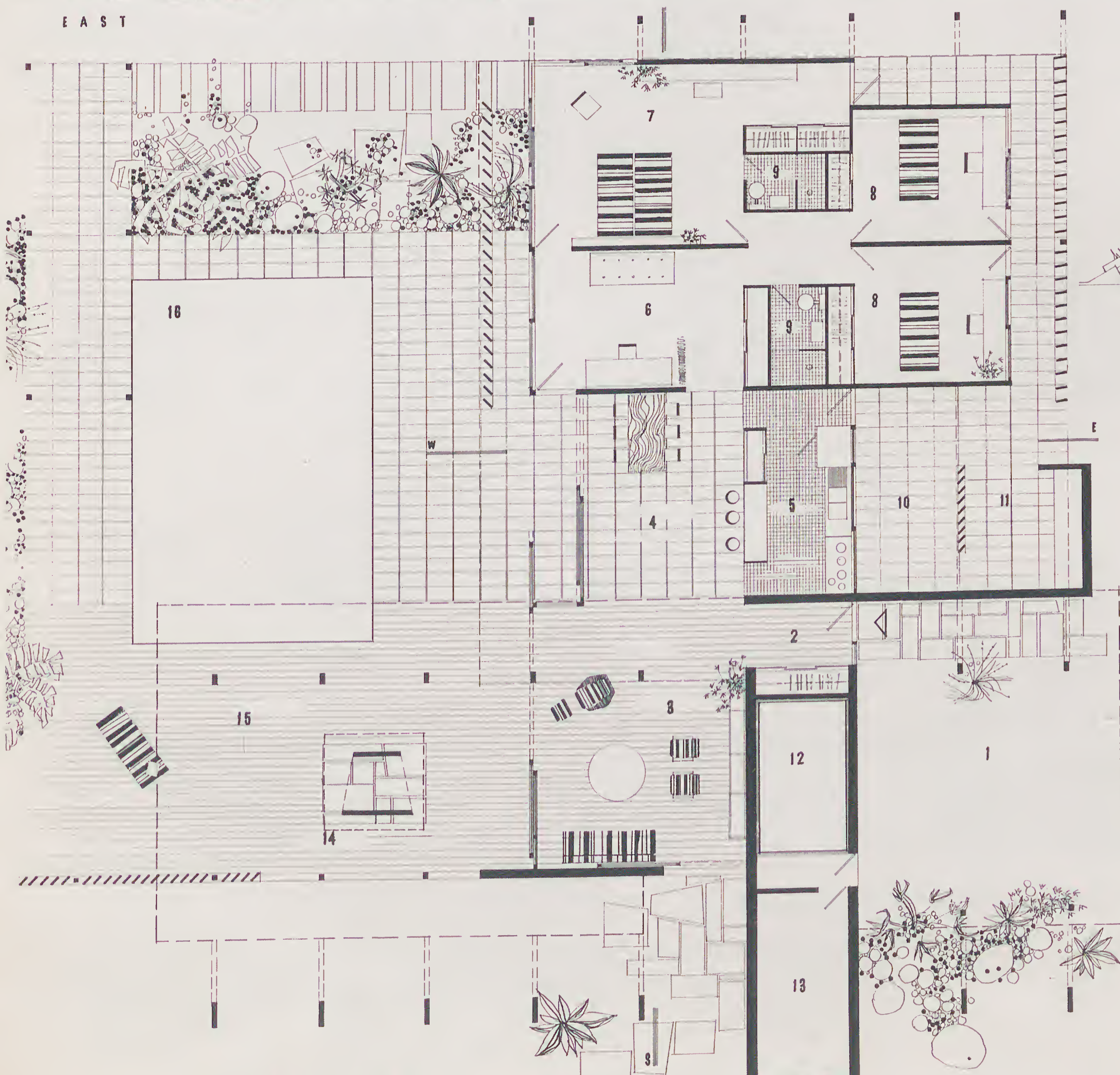




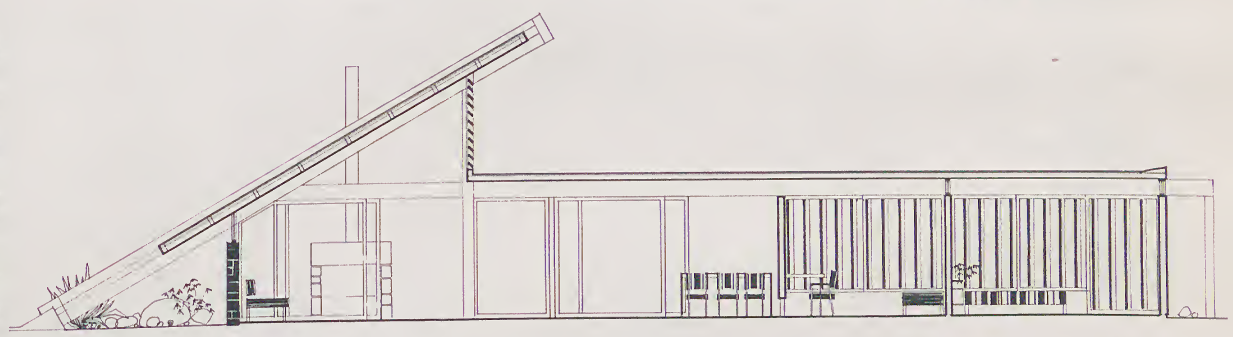
EAST



NORTH



FLOOR PLAN

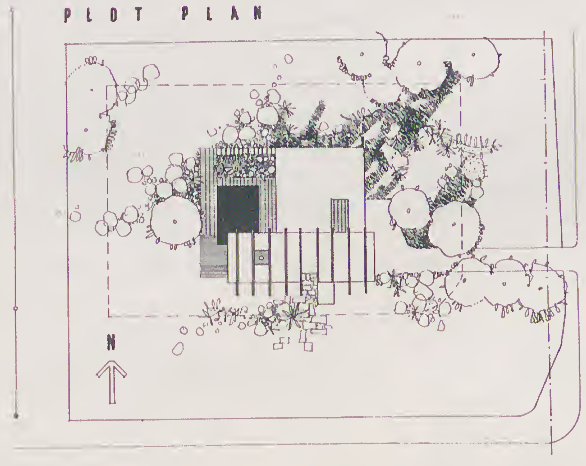


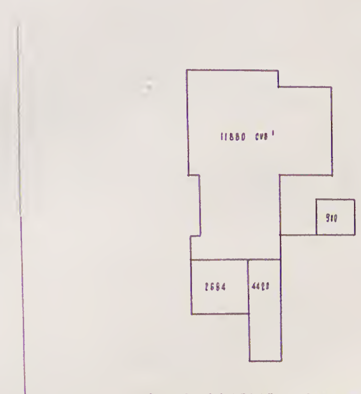
SECTION · NS

1 CAR PORT
2 ENTRANCE LOBBY
3 LIVING AREA
4 DINING AREA
5 KITCHEN
6 STUDY
7 MASTER BEDROOM
8 CHILDRENS BEDROOMS
9 BATH ROOMS
10 SERVICE YARD
11 UTILITY AREA
12 HEAT STORAGE TANK
13 INSTRUMENT ROOM
14 BARBACUE
15 OUTDOOR DECK AREA
16 SWIMMING POOL

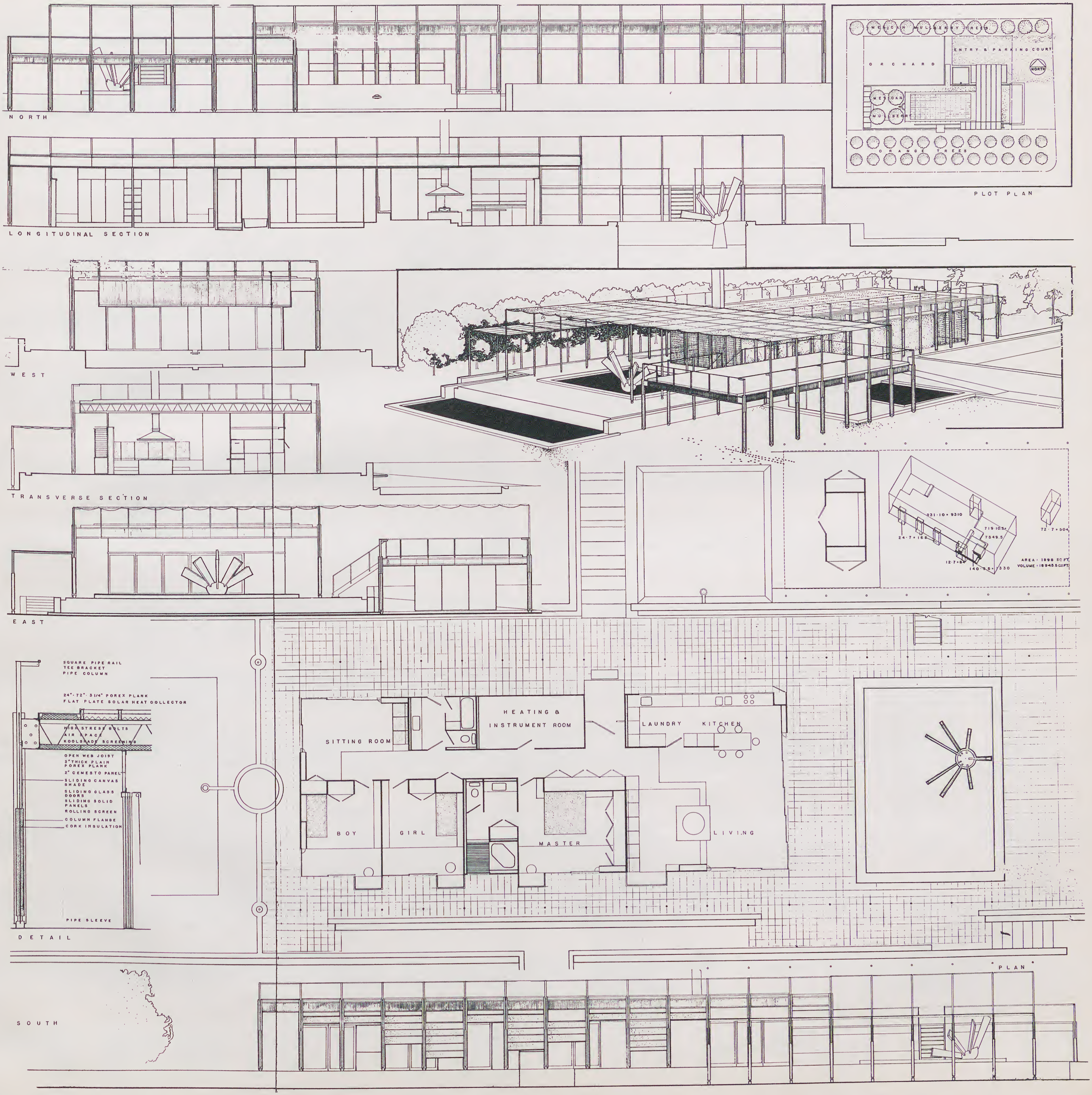
SECTION · EW

PLOT PLAN

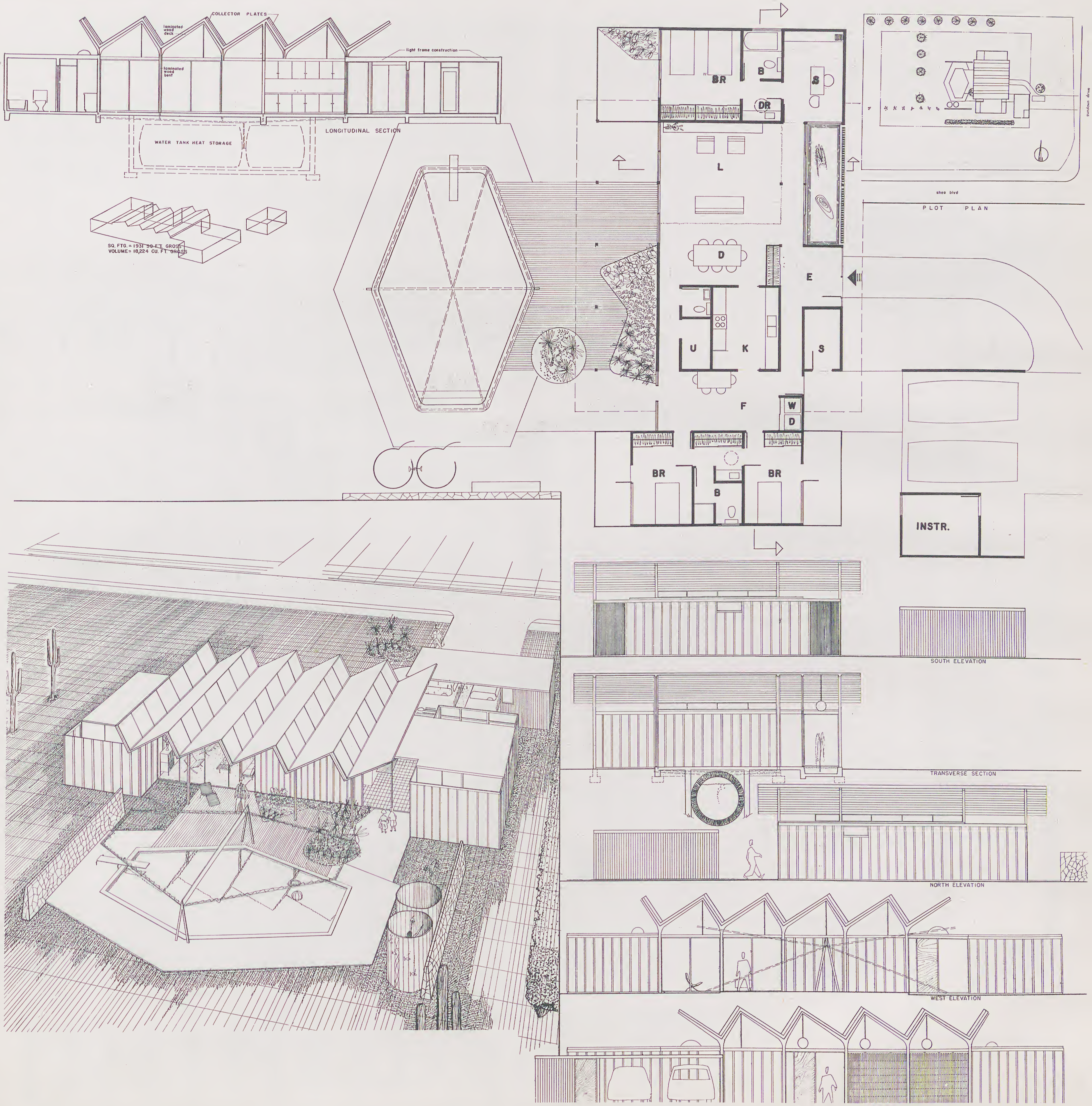


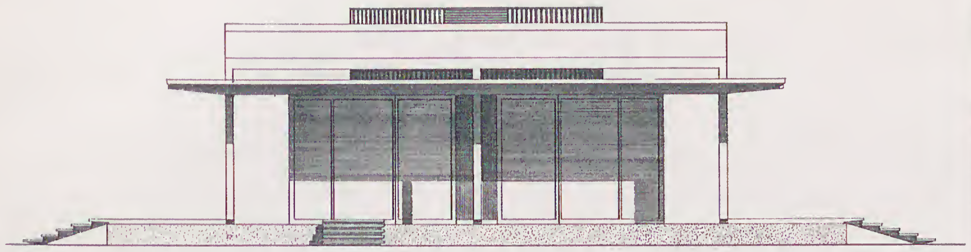


CUBIC CONTENT 19984 CUB.'

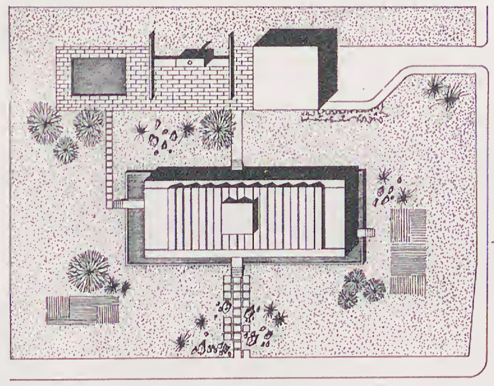

NORTH
LONGITUDINAL SECTION
MEXICAN MULBERRY TREES
ENTRY & PARKING COURT
ORCHARD
NORTH
MEXICAN MULBERRY
ORANGE TREES
PLOT PLAN
WEST
TRANSVERSE SECTION
EAST
SQUARE PIPE RAIL
TEE BRACKET
PIPE COLUMN
24"-72"-3 1/4" POREX PLANK
FLAT PLATE SOLAR HEAT COLLECTOR
HIGH STRESS BOLTS
AIR SPACE
KOOLSHADE SCREENING
OPEN WEB JOIST
3" THICK PLAIN POREX PLANK
2" CEMESTO PANEL
SLIDING CANVAS SHADE
SLIDING GLASS DOORS
SLIDING SOLID PANELS
ROLLING SCREEN
COLUMN FLANGE
CORK INSULATION
PIPE SLEEVE
DETAIL
SITTING ROOM
HEATING & INSTRUMENT ROOM
LAUNDRY
KITCHEN
BOY
GIRL
MASTER
LIVING
PLAN
SOUTH

38 PERSHING C. LIN, San Francisco, Calif.

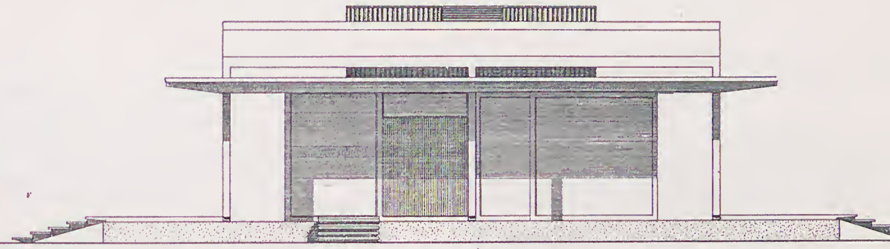




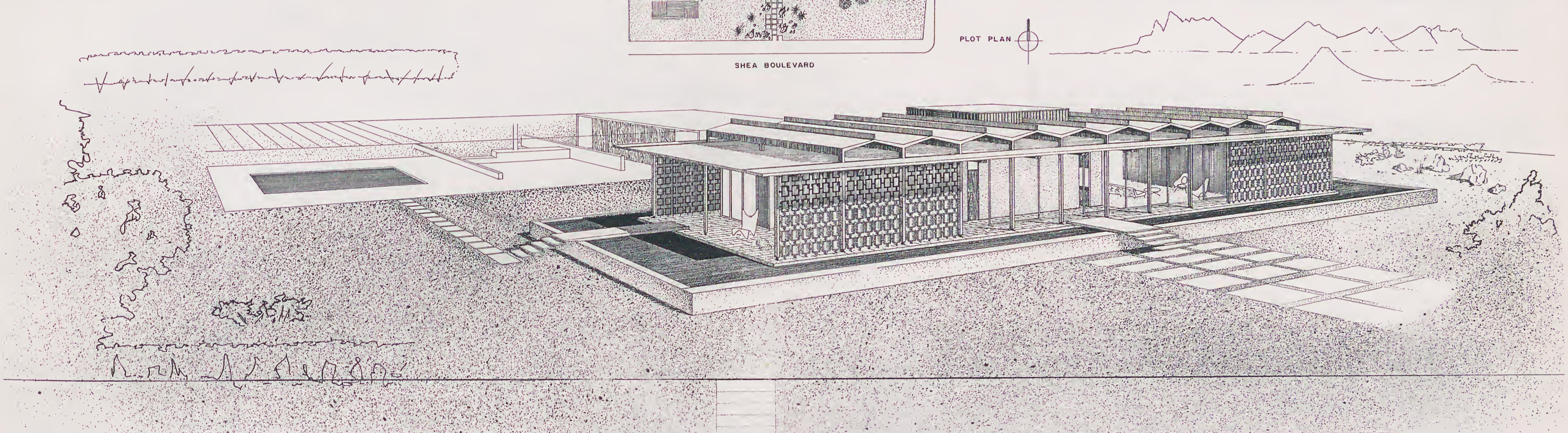
EAST ELEVATION

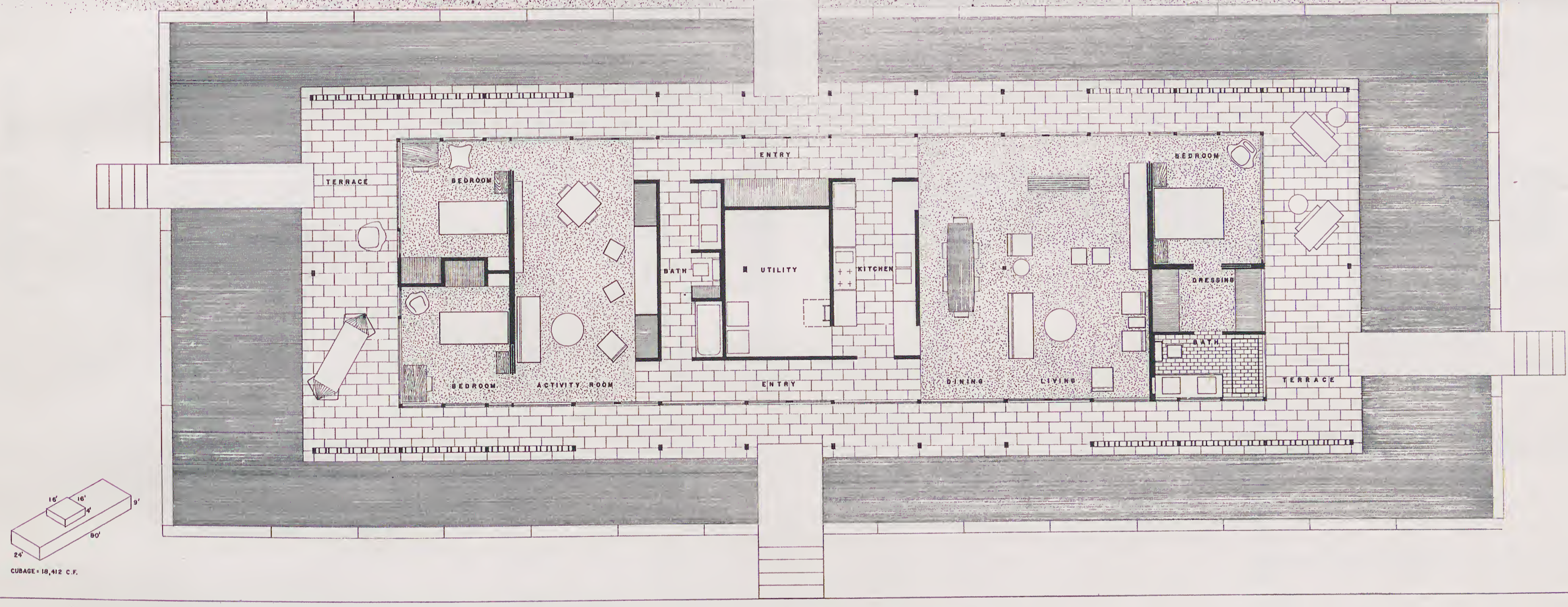


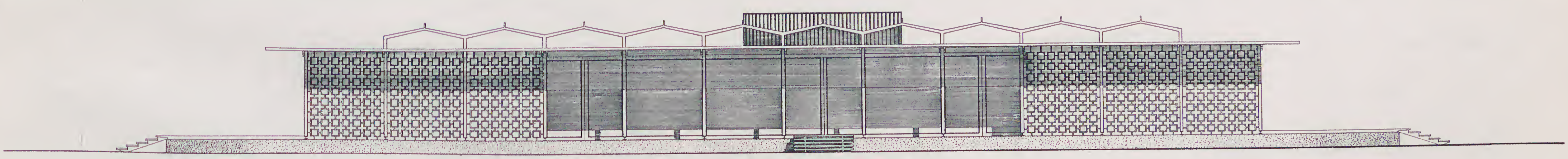
PLOT PLAN



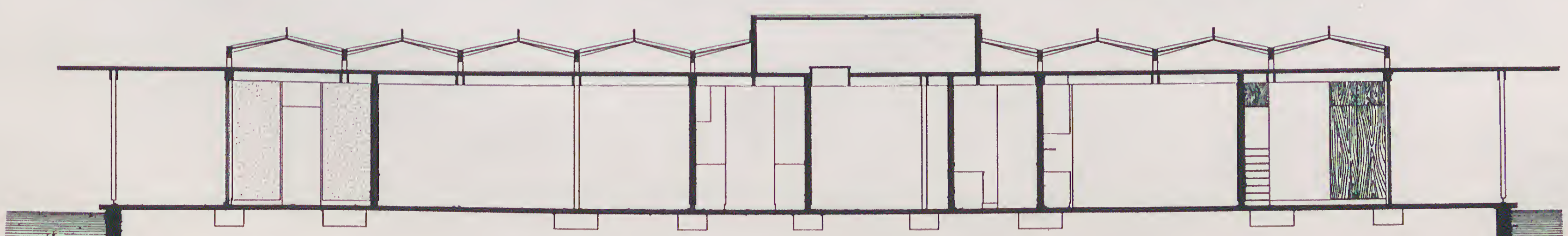
WEST ELEVATION



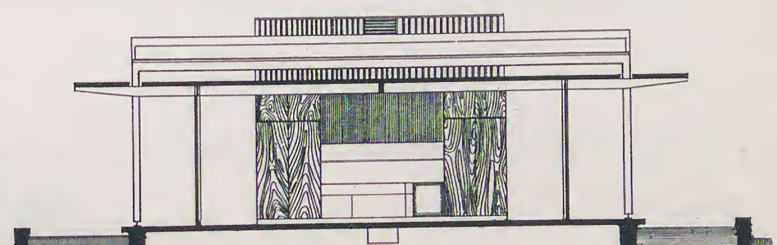




NORTH ELEVATION - SOUTH SIMILAR

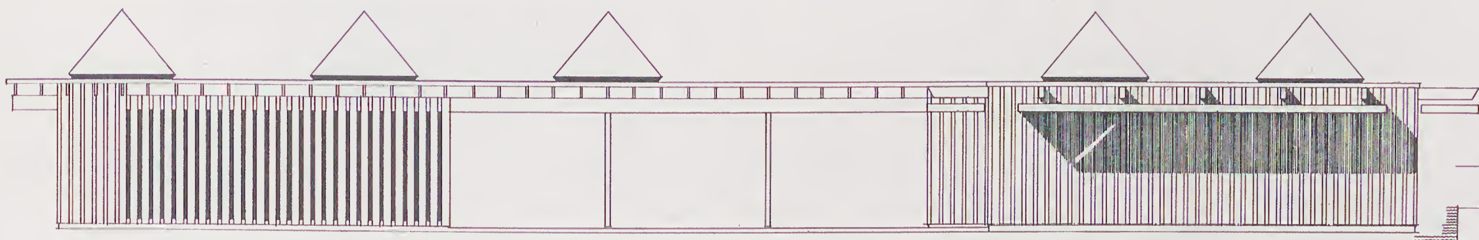


SECTION LOOKING SOUTH

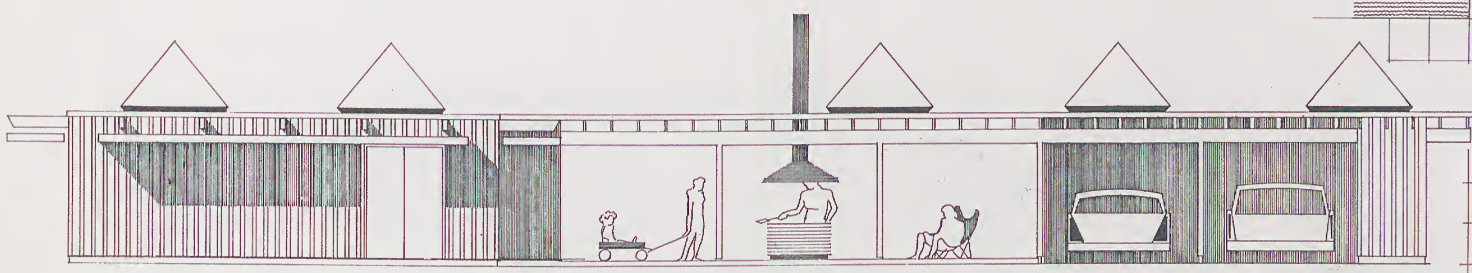


SECTION THRU ACTIVITY ROOM LOOKING EAST

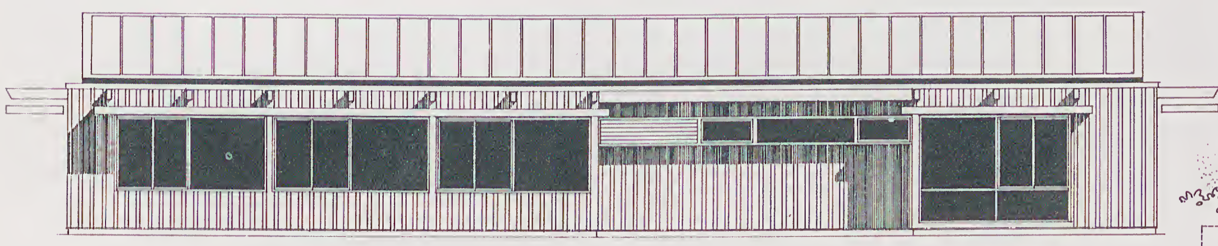
JAMES A. NASH, Weehawken, N.J.



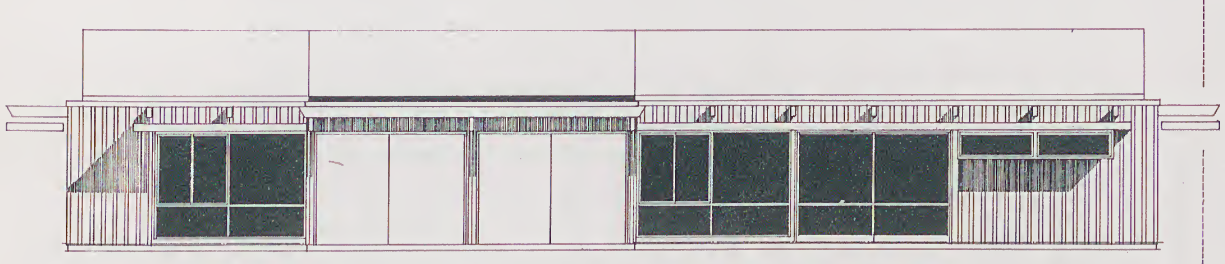
WEST ELEVATION



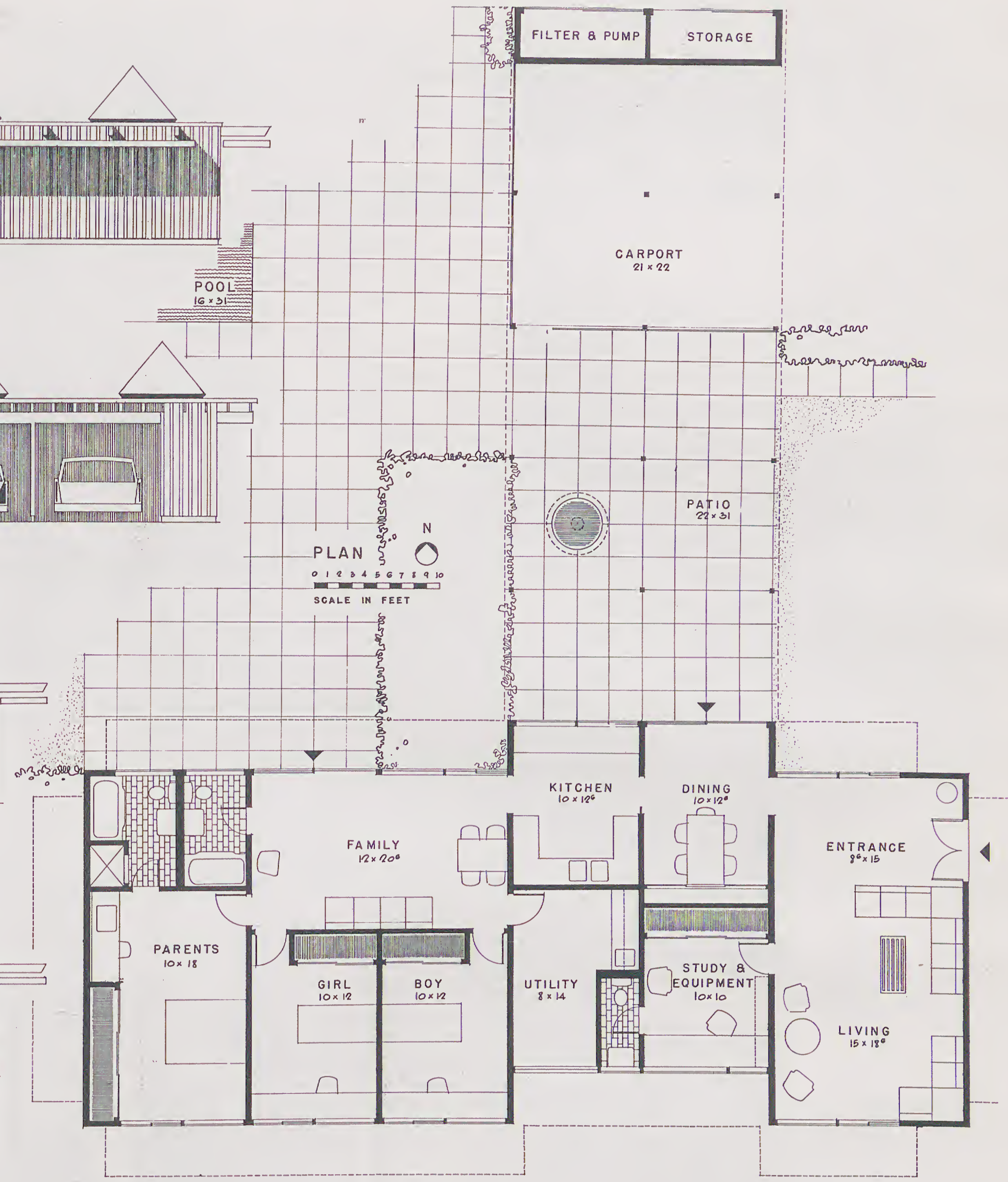
EAST ELEVATION

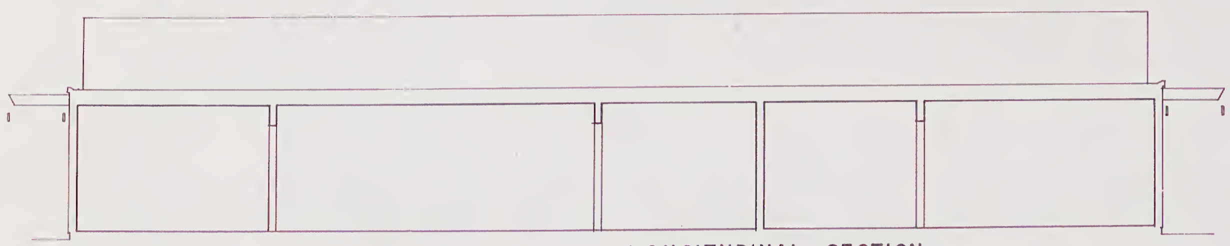


SOUTH ELEVATION

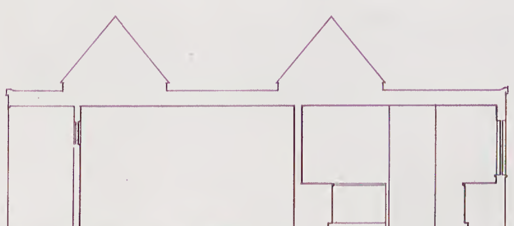


NORTH ELEVATION

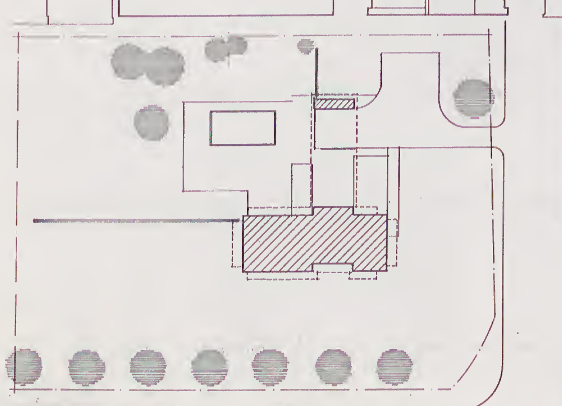




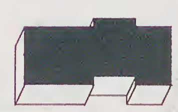
LONGITUDINAL SECTION



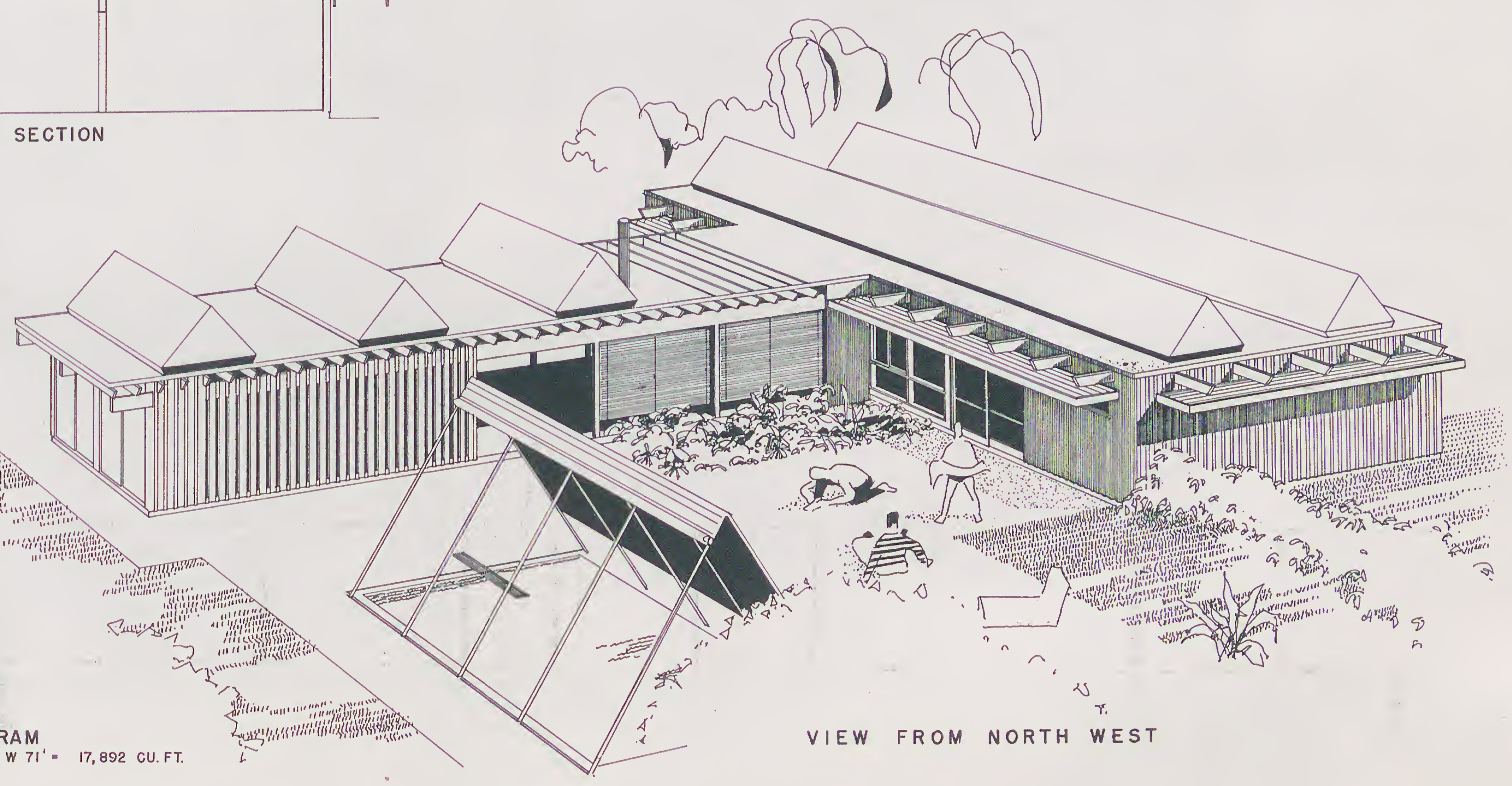
TRAVERSE SECTION



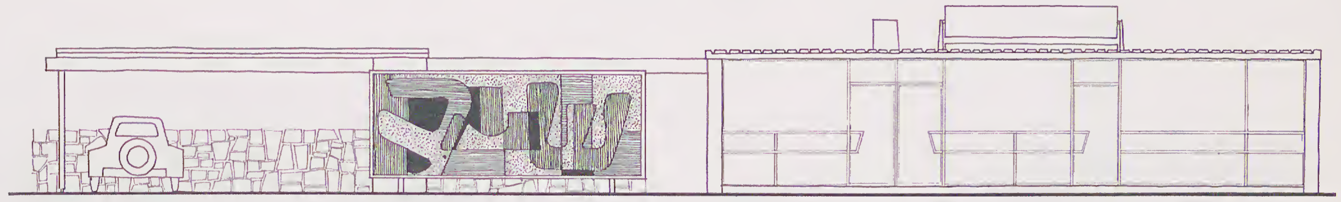
PLOT PLAN SHEA BLVD.



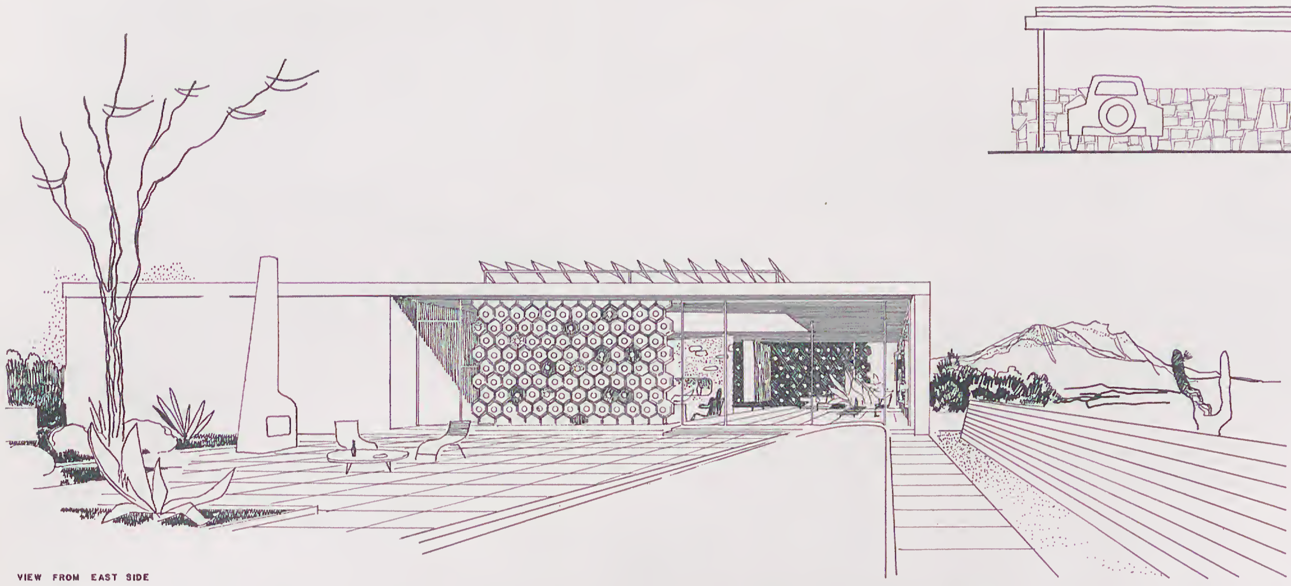
VOLUME DIAGRAM
H 9' X L 28' X W 71' = 17,892 CU. FT.



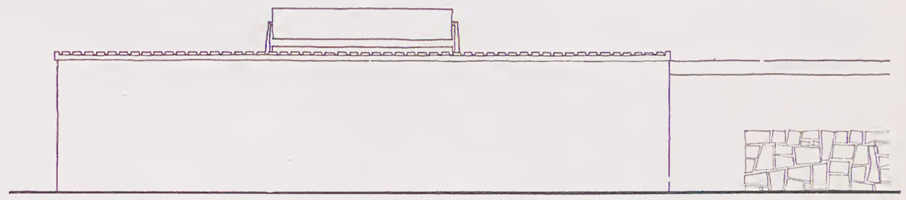
VIEW FROM NORTH WEST



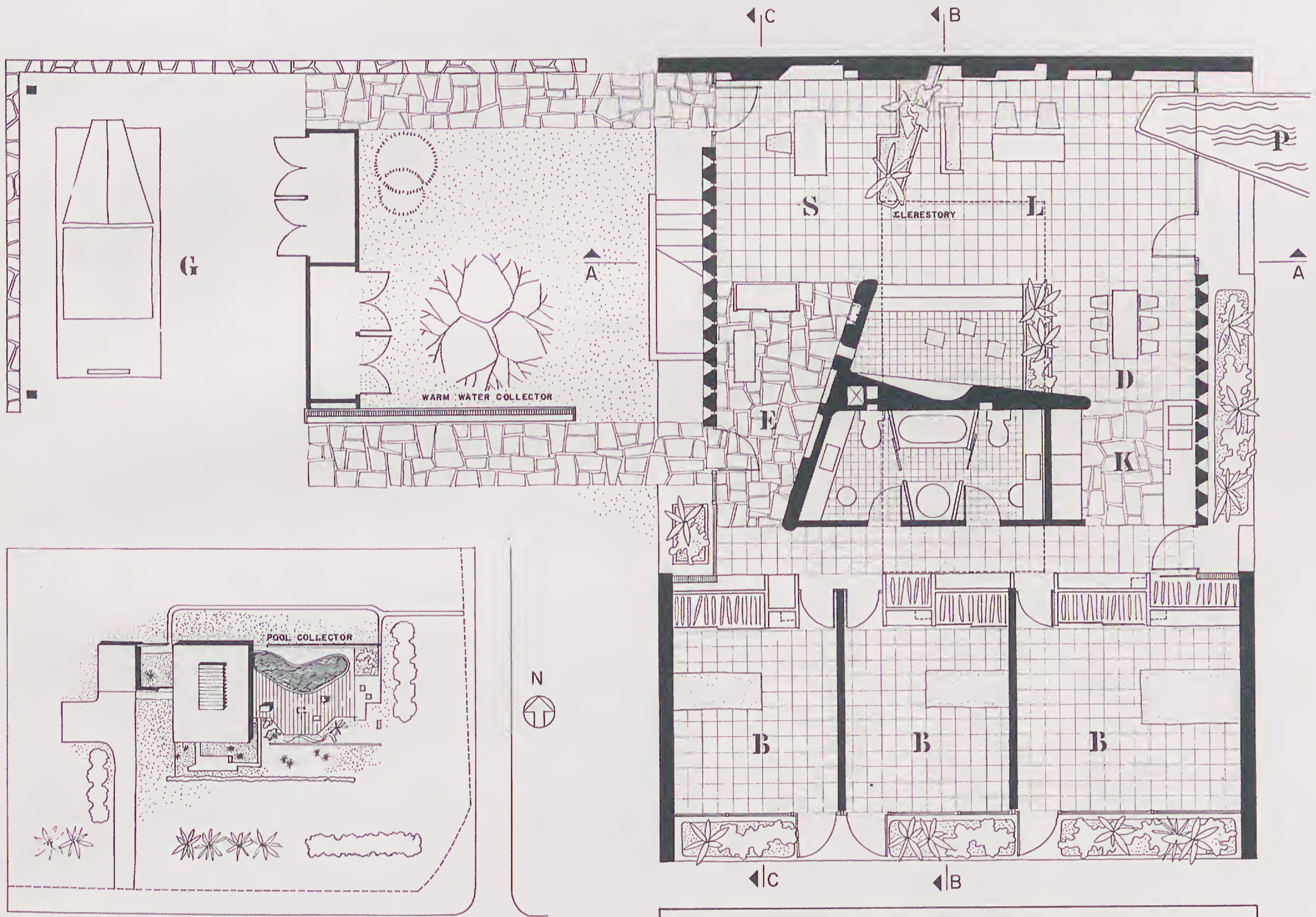
SOUTH



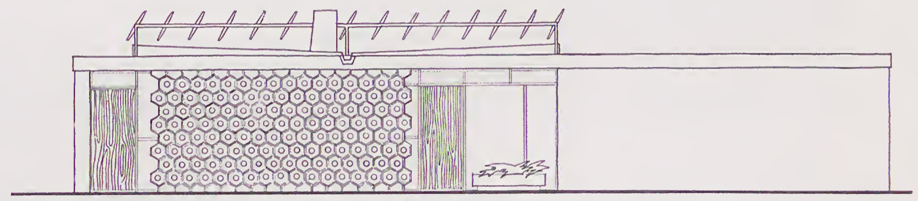
VIEW FROM EAST SIDE



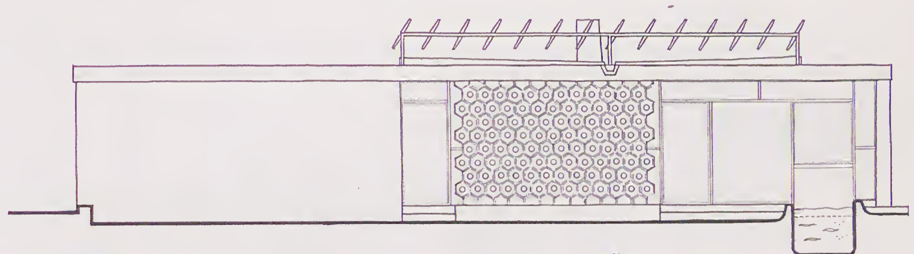
NORTH



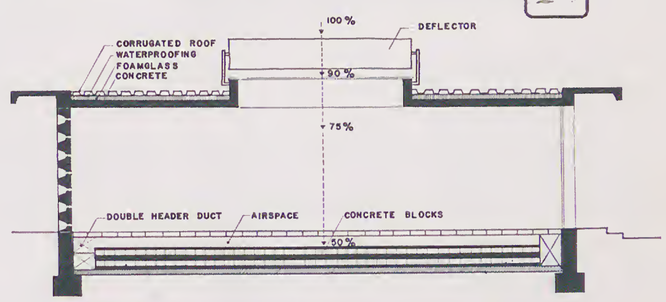
SHEA BOULEVARD

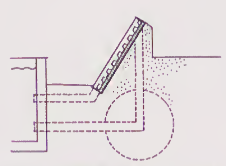


EAST



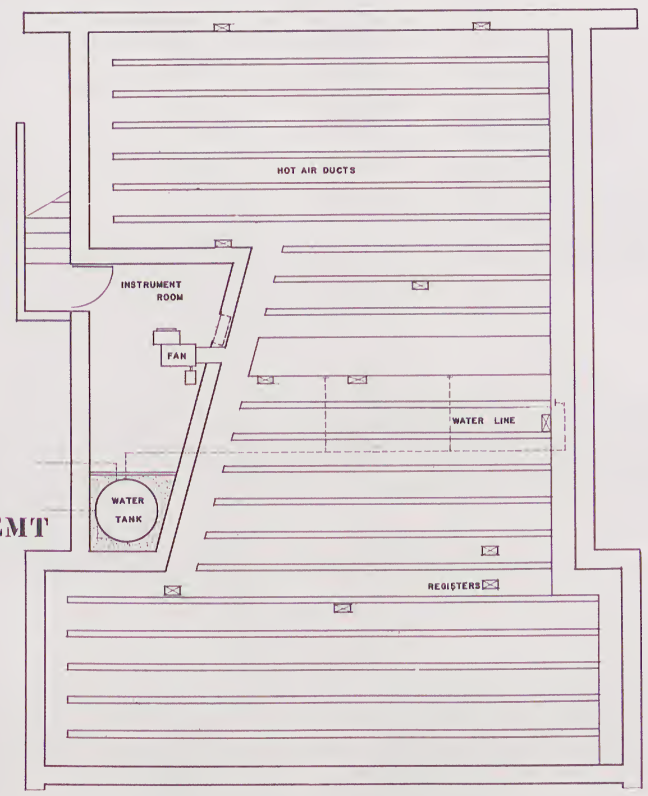
WEST



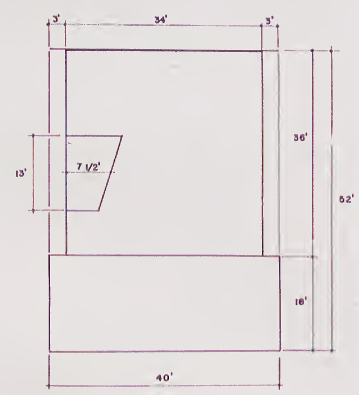


SECTION THROUGH POOL COLLECTOR

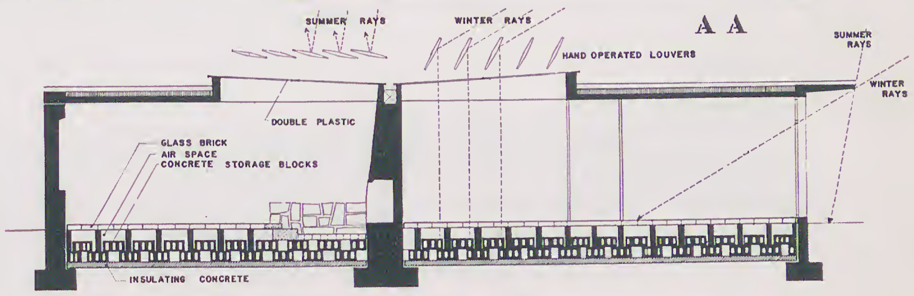
A A



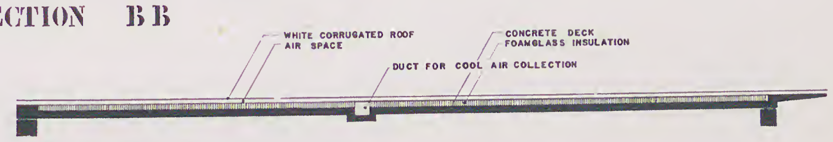
BSEMT



FLOOR 1220 SQ. FT.
640
1860
BASEMENT 100
TOTAL 1960 SQ. FT.

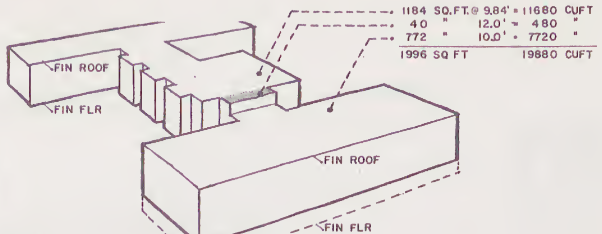


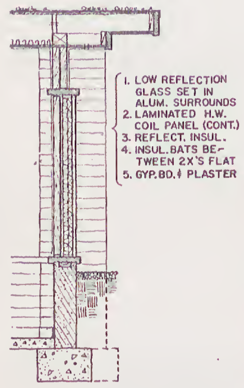
SECTION BB

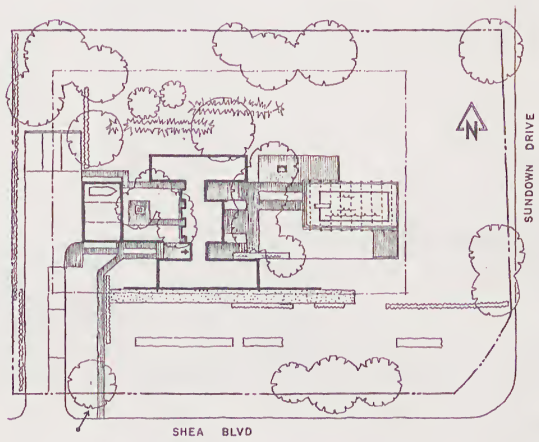


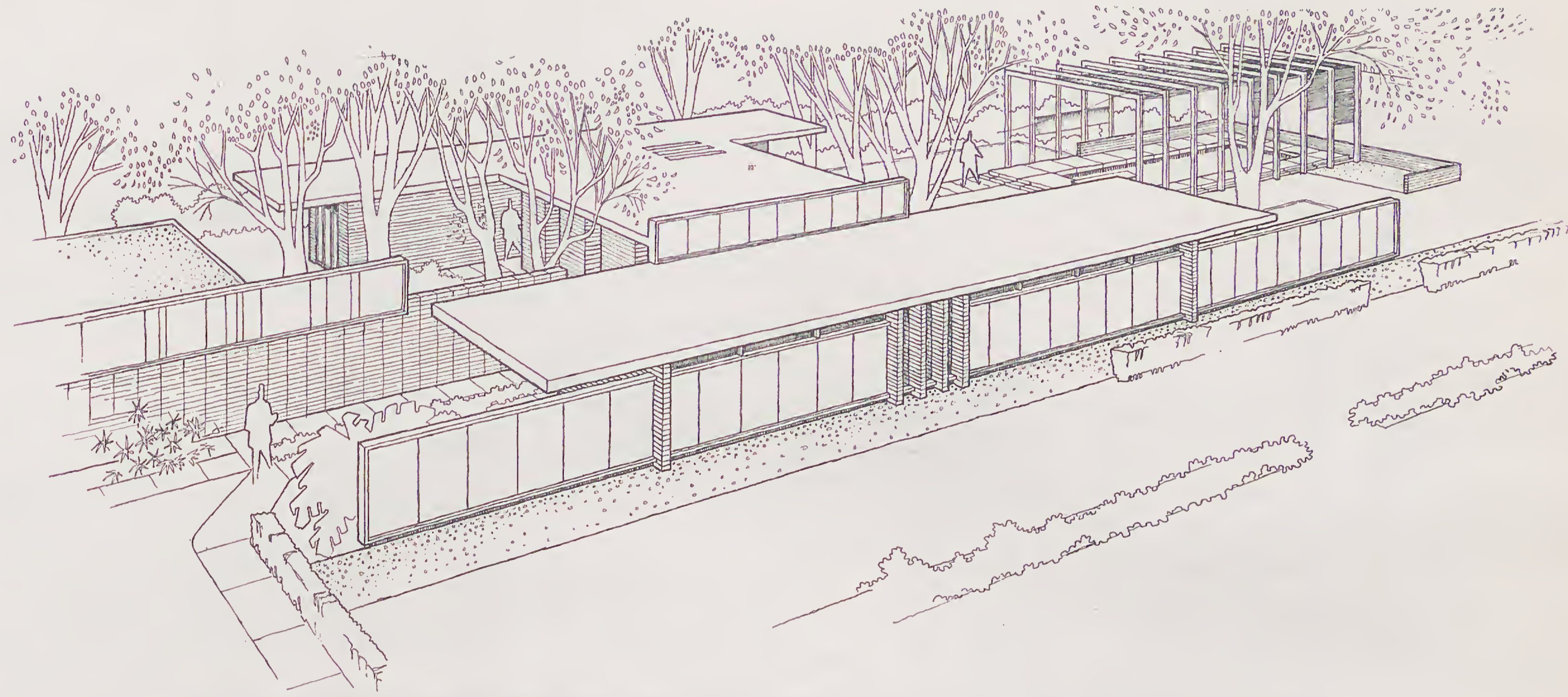
CC

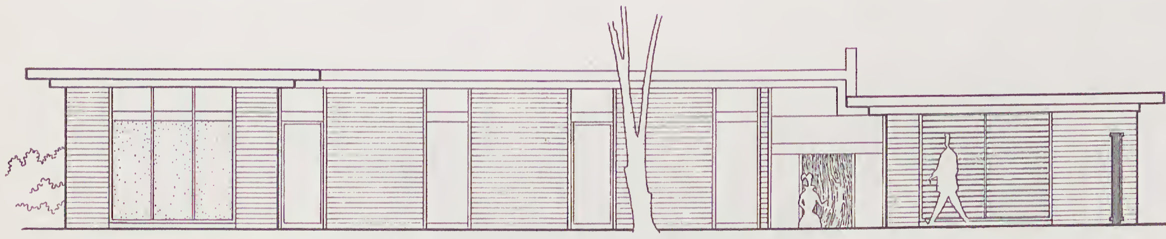
42 OSCAR R. PADJEN, Beverly, Mass.







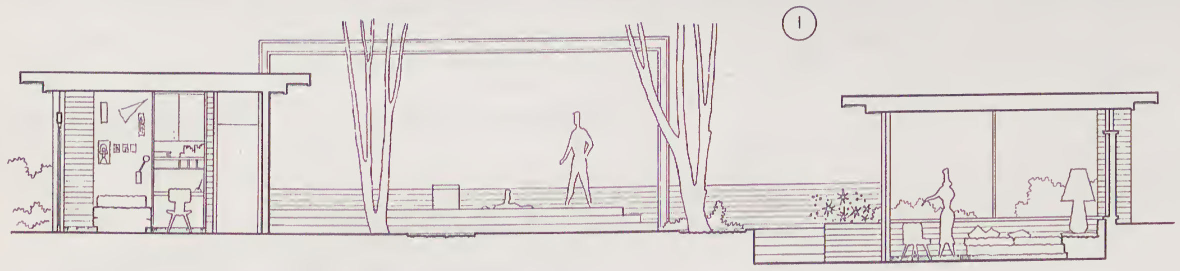




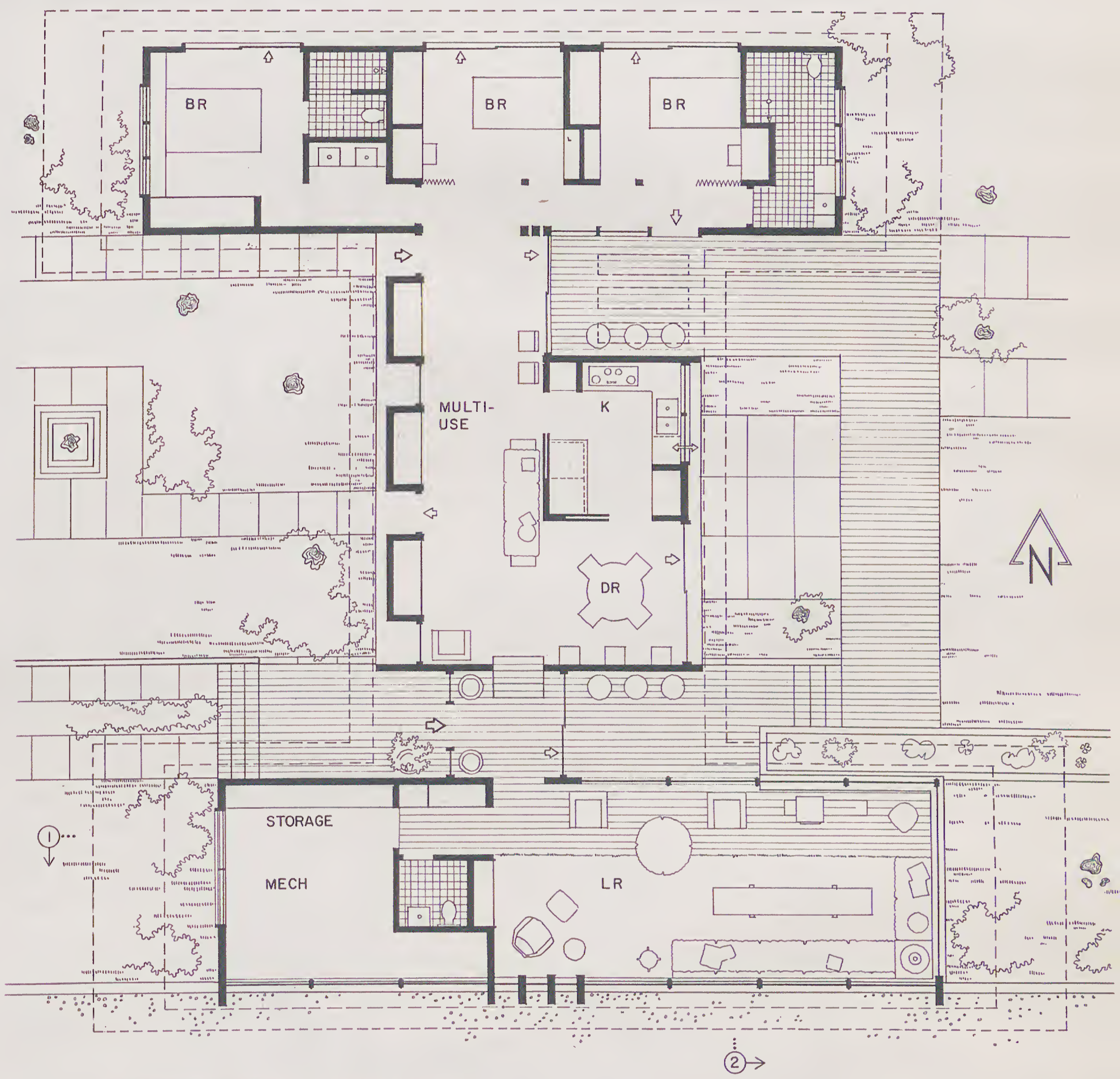
W

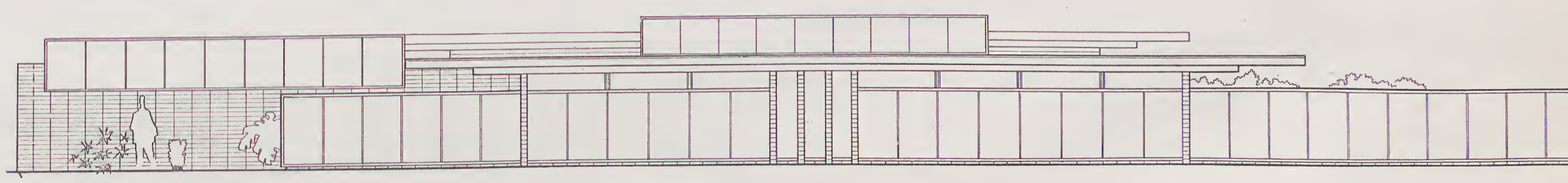
E

1

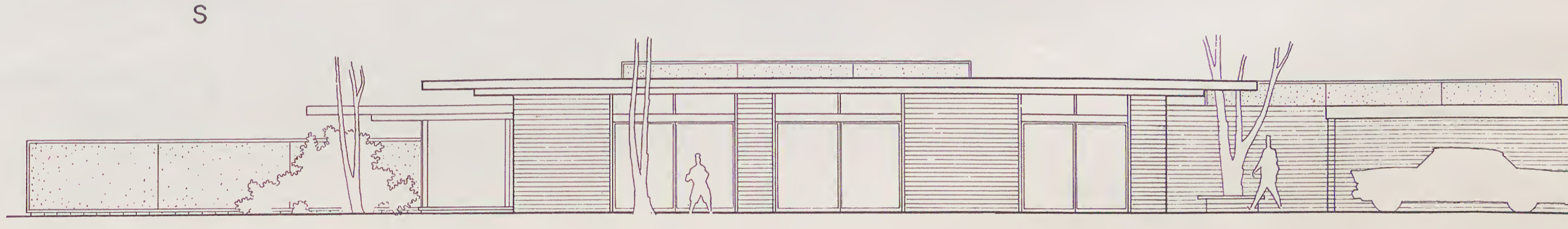


2

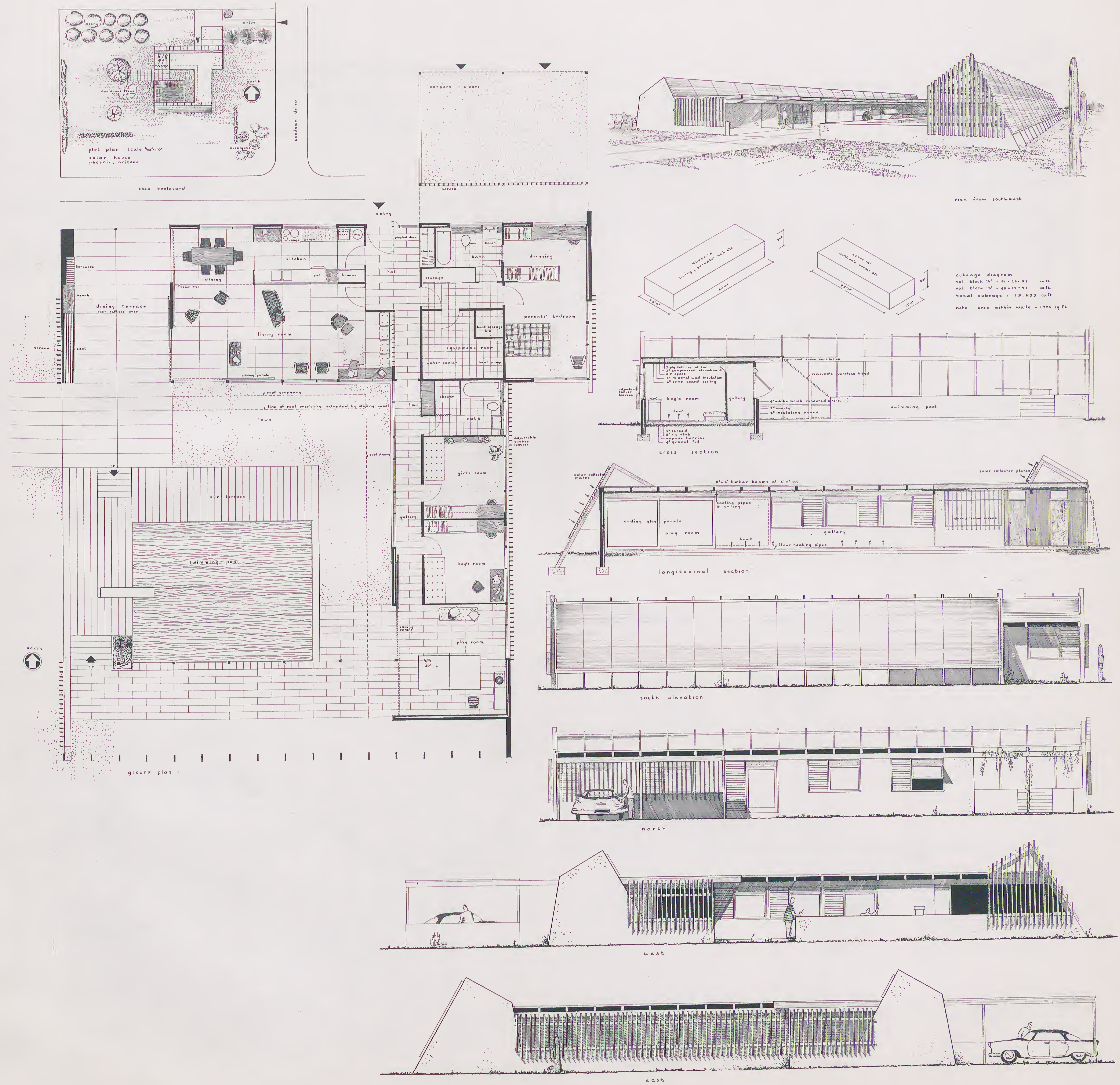




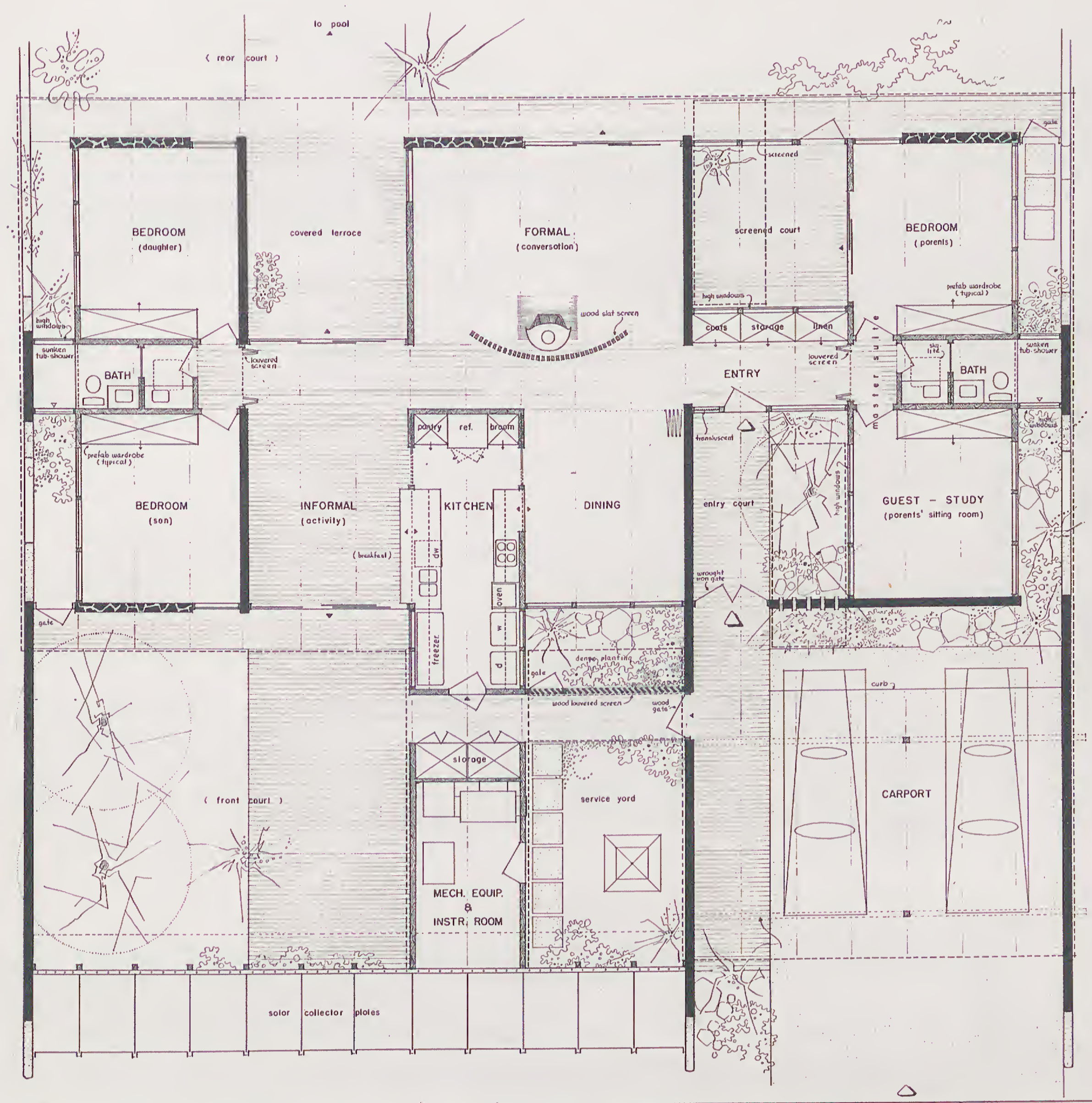
S



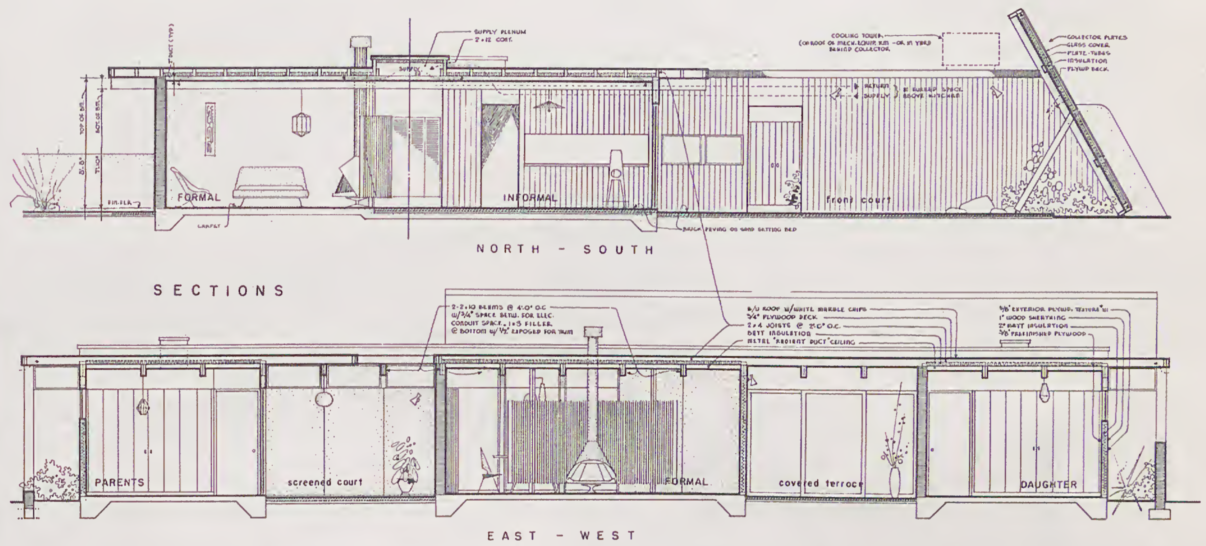
N


plot plan
solar house
phoenix, arizona
sundown drive
north
carport · 2 cars
view from south-west
entry
hall
kitchen
dining
living room
dining terrace
bath
dressing
parents' bedroom
equipment room
storage
girl's room
boy's room
play room
gallery
lawn
sun terrace
swimming pool
ground plan
cubeage diagram
cross section
longitudinal section
south elevation
north
west
east

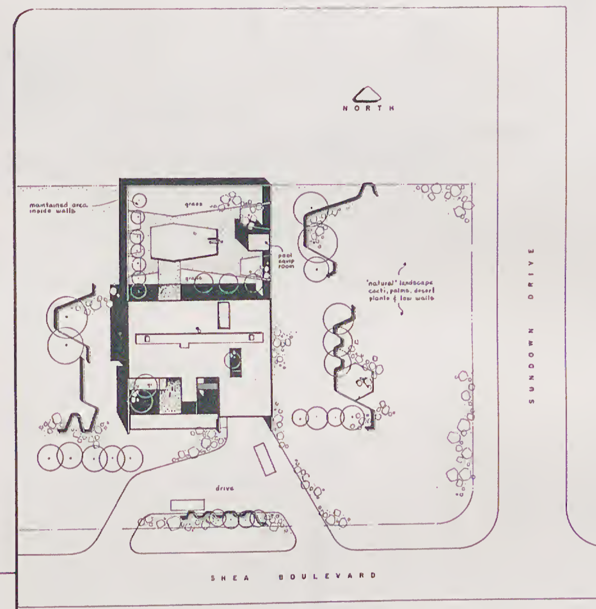
JOHN B. REED, Jr., Albuquerque, N.M.



PLAN

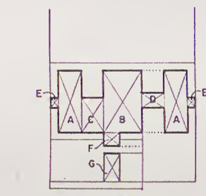


SECTIONS



PLOT

AREA-CUBAGE DIAGRAM beneath typewritten sheets

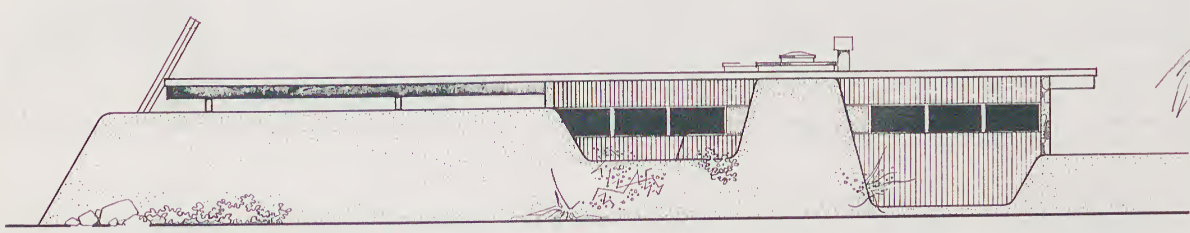


AREA

2A	=	2 (12 X 33)	=	792
B	=	20 X 33	=	660
C	=	12 X 19	=	228
D	=	7 X 12	=	84
2E	=	2 (4 X 4.5)	=	36
F	=	8 X 6	=	48
G	=	8 X 15	=	120
total (sq.ft.)			=	1968

CUBAGE

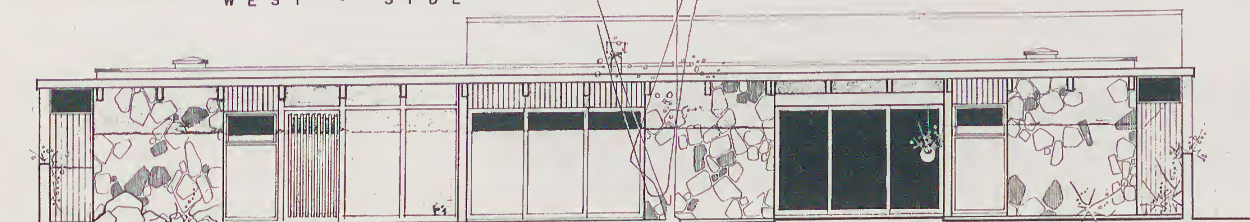
1968 X 8'-6" = 16728 cu. ft.



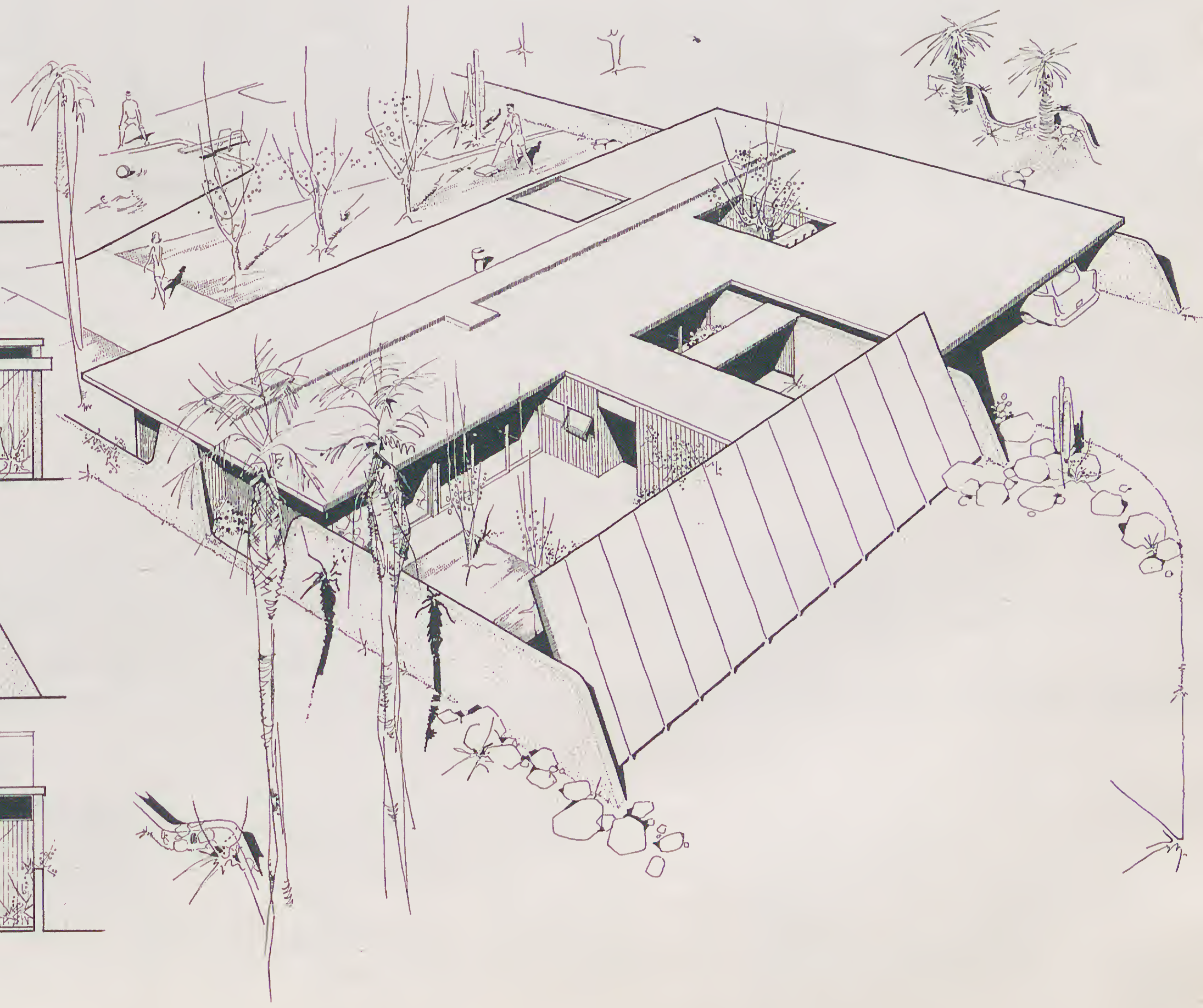
EAST • SIDE

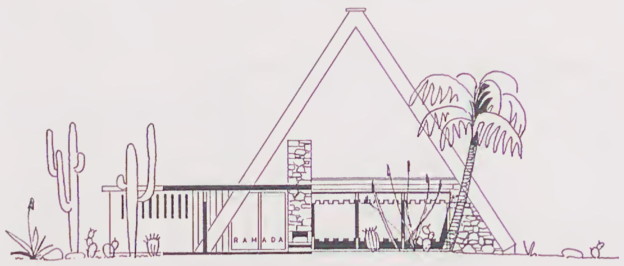
SOUTH • FRONT

WEST • SIDE

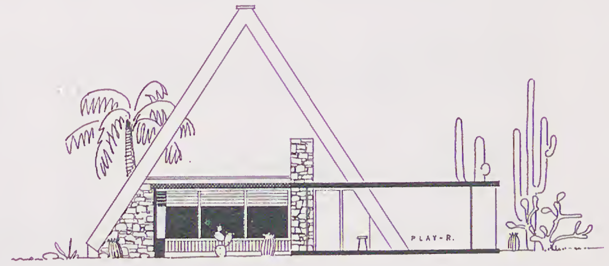


NORTH • REAR

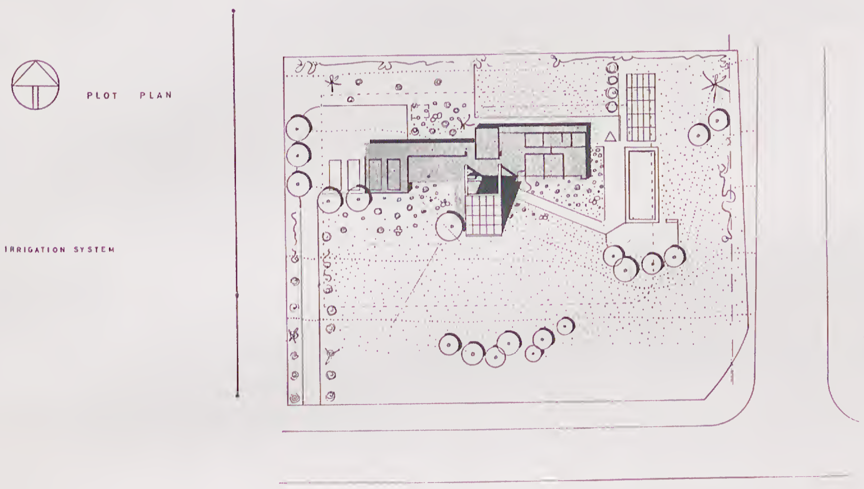


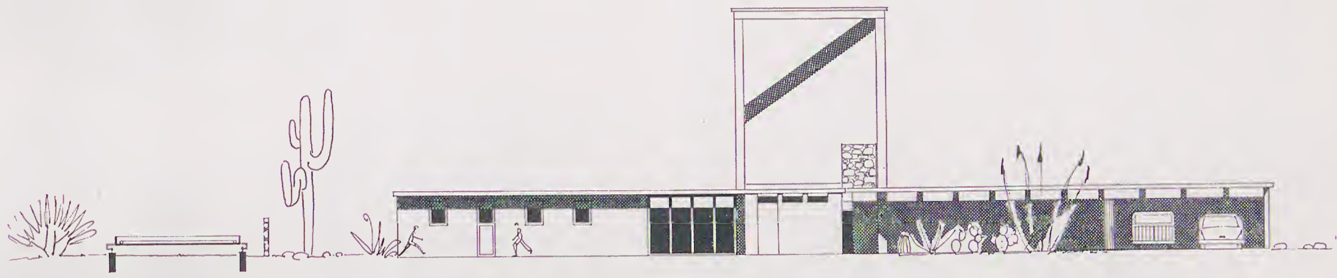


WEST ELEVATION

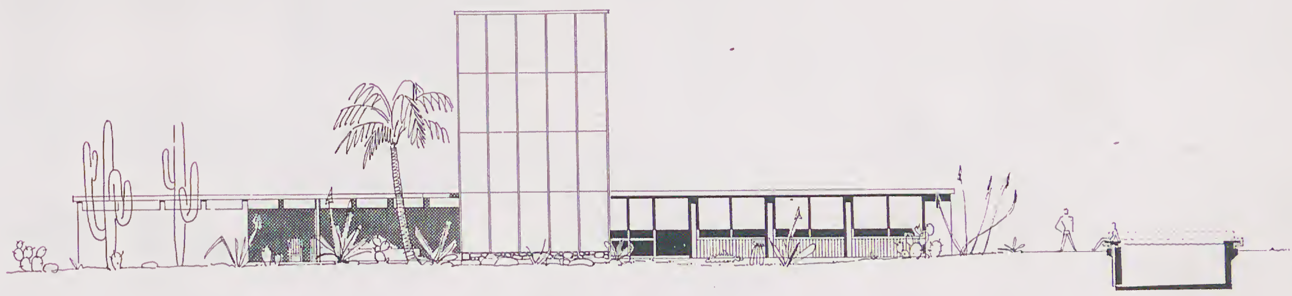


EAST ELEVATION

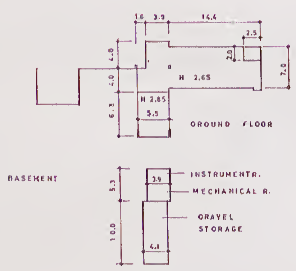




NORTH ELEVATION

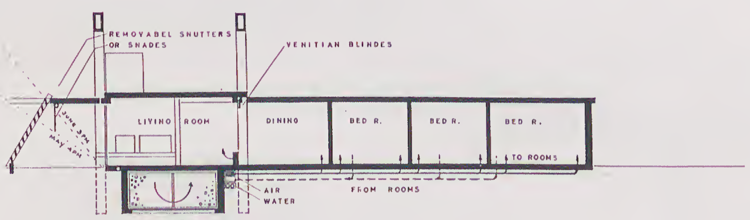


SOUTH ELEVATION

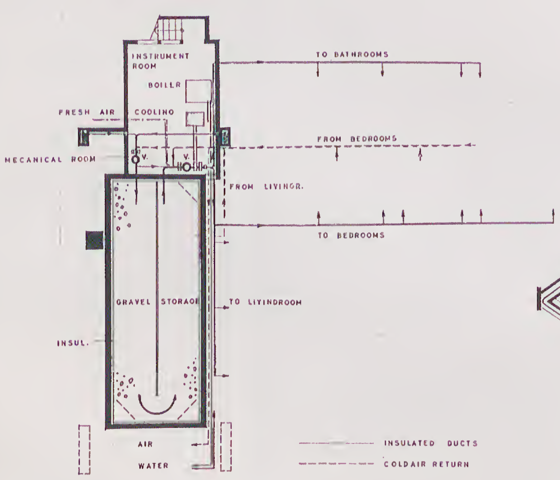


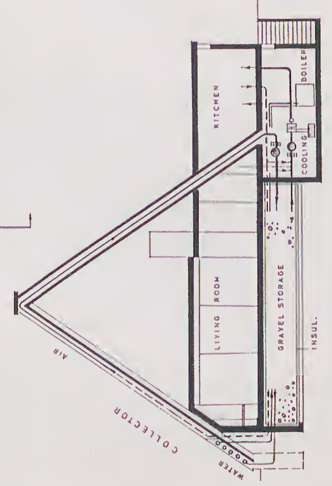
ROOMS		M2	SQFT	HEIGHT		M3	CUBIC FEET
LIVING	5.5 M × 6.8 M =	37.4	(402)	× 3.85 M	(9'-4")	106.5 M2	
KITCHEN	3.9 M × 4.0 M =	15.6	(168)	× 2.65 M	(8'-8")	41.3 M3	
ENTRANCE	5.5 M × 4.0 M =	22.0	(337)	× 2.65 M		58.3 M3	
DINING+B.R.	14.4 M × 7.0 M =	100.8	(1064)	× 2.65 M		274.5 M3	
	2.5 M × 2.0 M −	5.0	(− 54)	× 2.65 M		− 13.2 M3	
TOTAL FLOOR AREAS		170.8 M2 ~ 1837 SQFT.				459.9 M3 ~ 16200 CUFT.	

		SQFT	HEIGHT		M3	CUBIC FEET
INSTRUMENT + MECHANICAL R.	3.8 M × 5.3 M = 20.6 M2	(222) ×	2.4 M	(7'-10")	49.5	1750
CHLORINATING + POOL FILTERING	2.5 M × 2.0 M = 5.0 M2	(54) ×	2.65 M	(8'-8")	13.3	470
GRAVEL STOR.	4.1 M × 10.0 M = 41.0 M2	(440) ×	1.65M	(5'-5")	67.6	2380 CUFT.



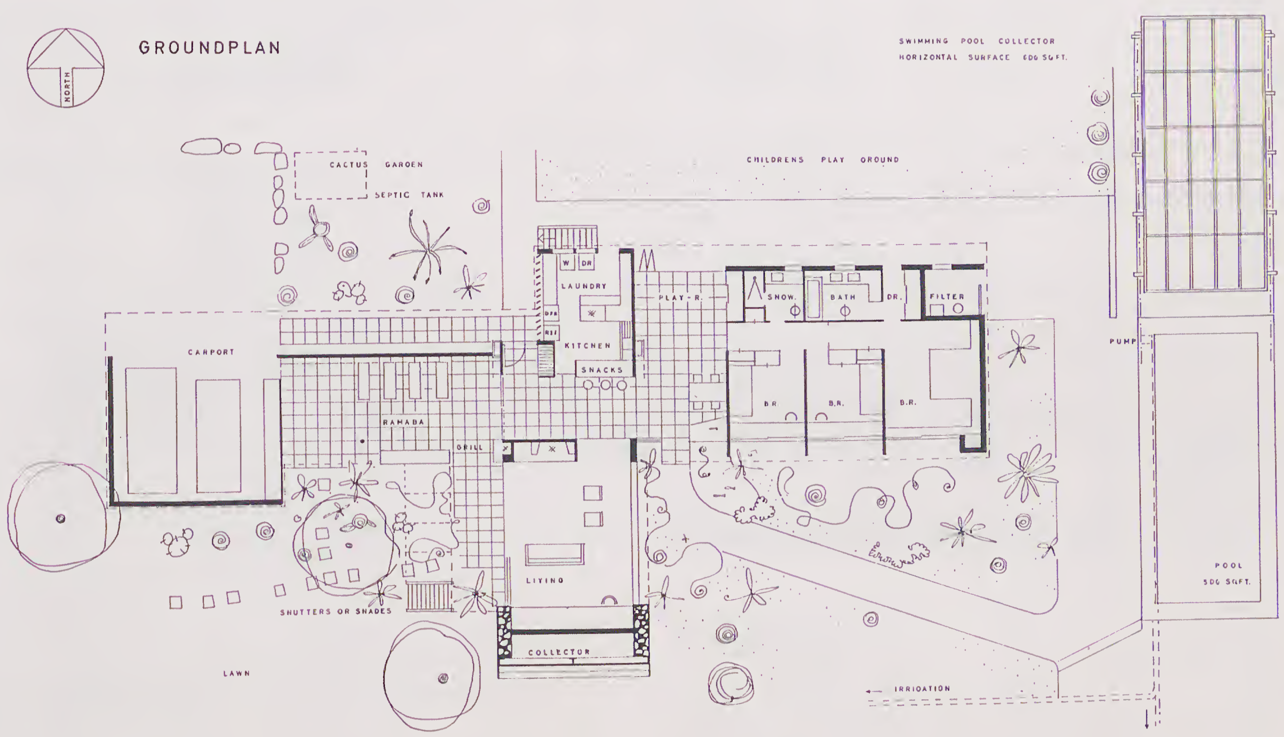
LONGITUDINAL SECTION

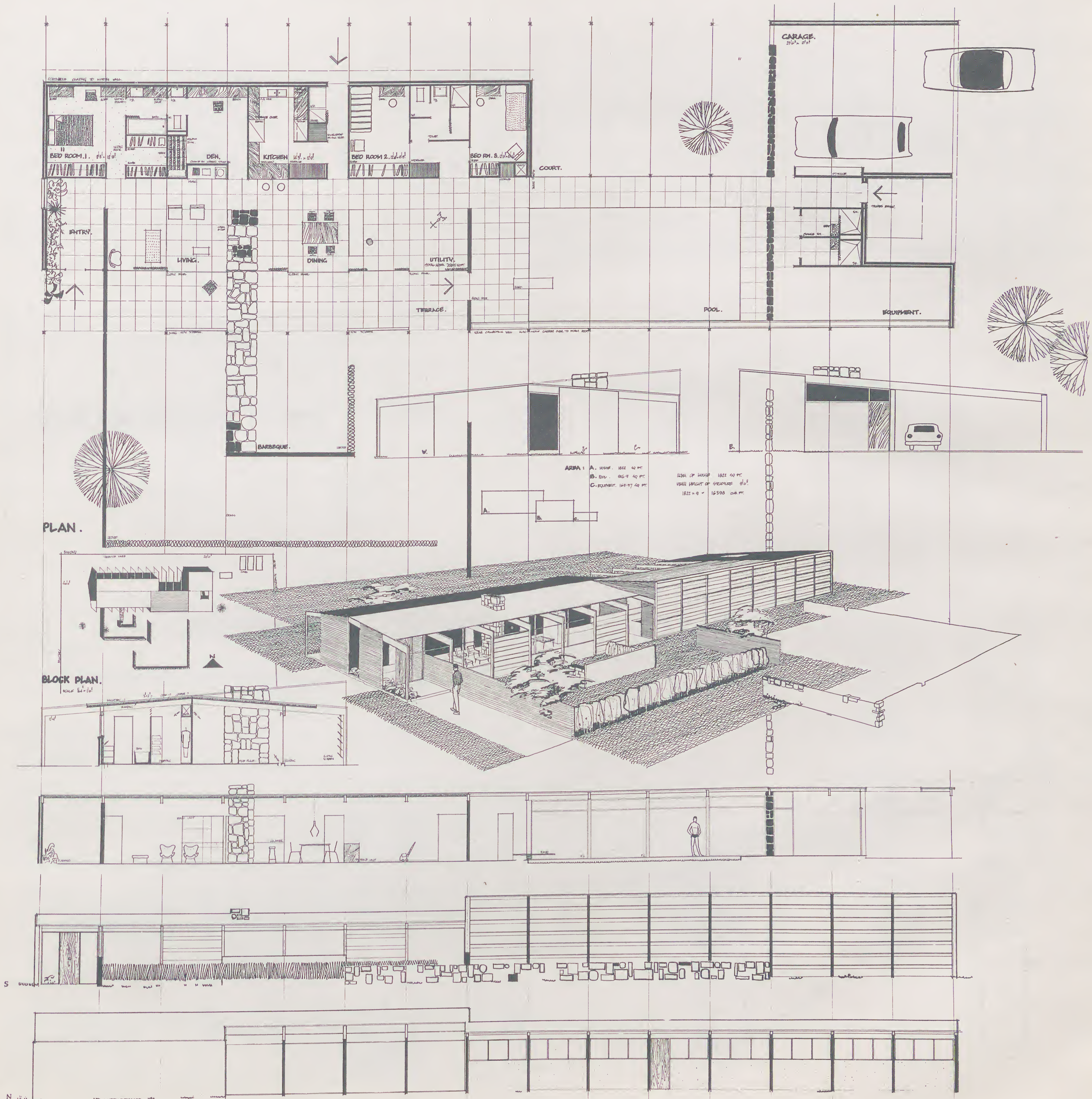


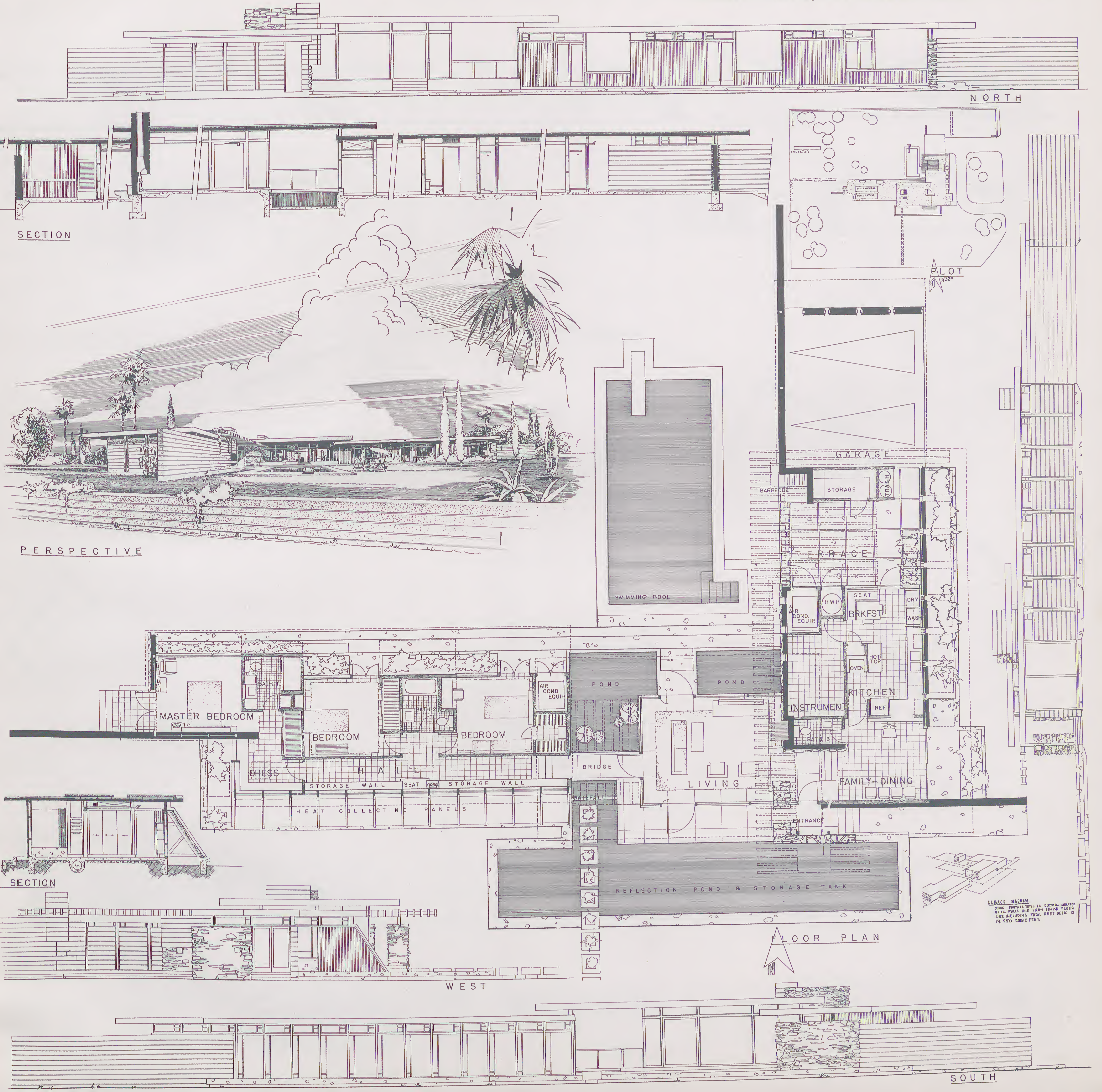


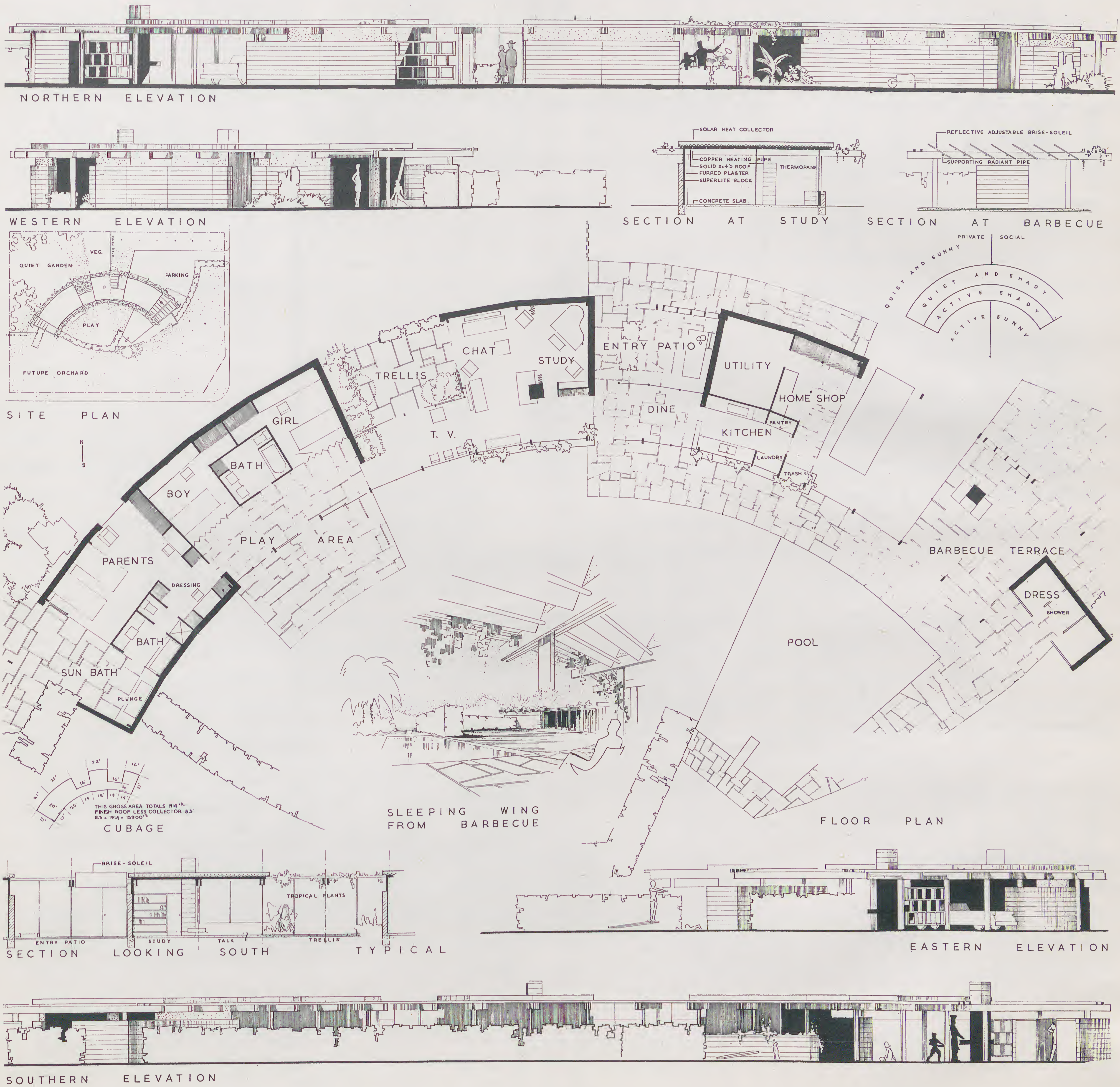
TRANSVERSE SECTION

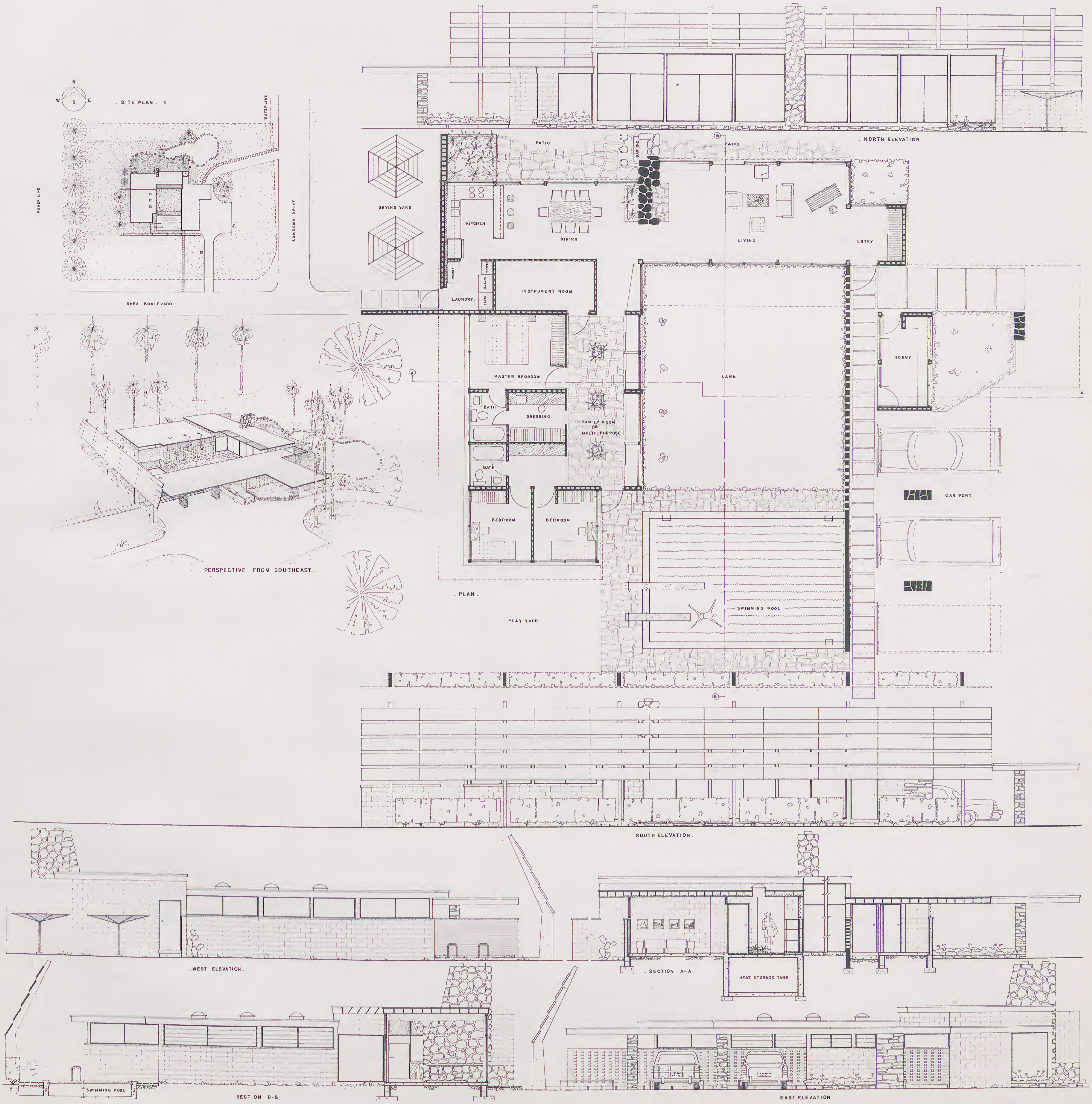
GROUNDPLAN



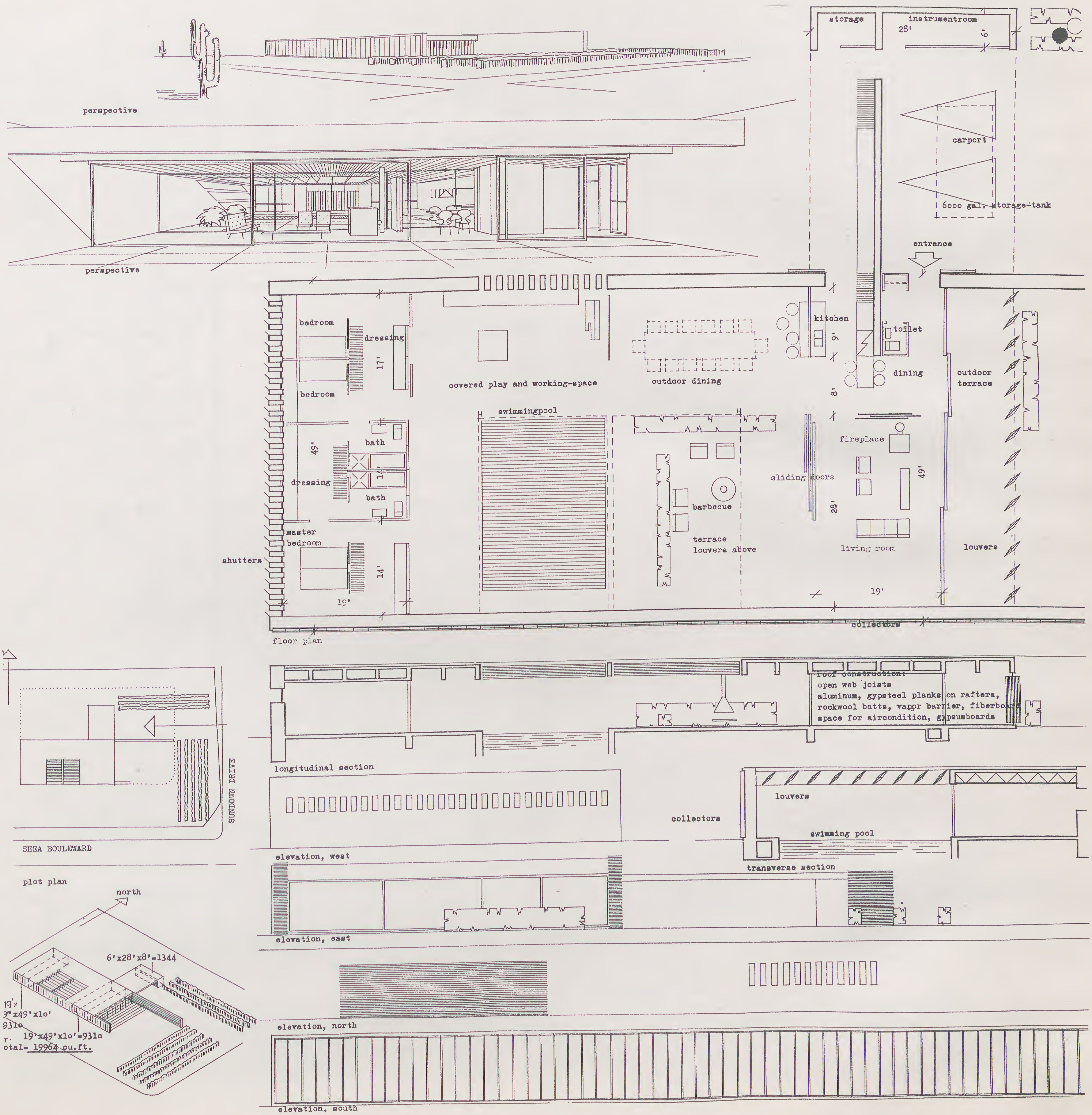

GARAGE.
BED ROOM.1.
DEN.
KITCHEN
BED ROOM 2.
BED RM. 3.
COURT.
ENTRY.
LIVING.
DINING
UTILITY.
TERRACE.
POOL.
EQUIPMENT.
BARBEQUE.
PLAN.
BLOCK PLAN.
W.
E.
S
N

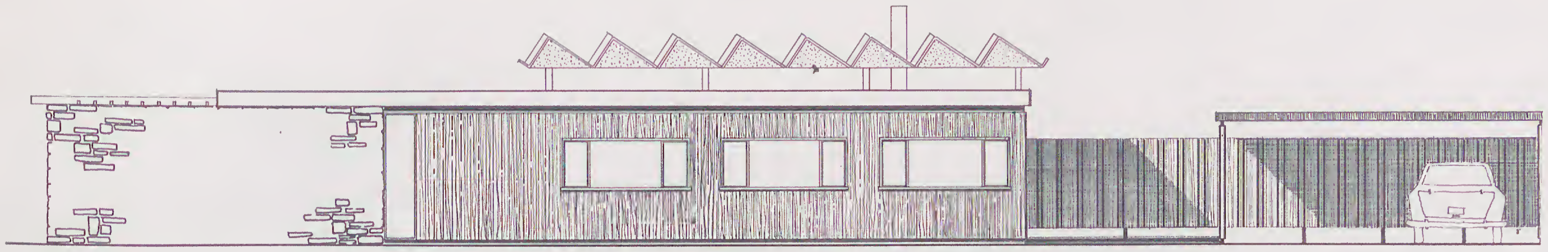

NORTH
SECTION
PLOT
PERSPECTIVE
GARAGE
STORAGE
TRASH
BARBECUE
TERRACE
SWIMMING POOL
AIR COND. EQUIP.
HWH
SEAT
BRKFST
DRY
WASH
HOT TOP
OVEN
KITCHEN
REF.
INSTRUMENT
BATH 3
FAMILY DINING
POND
POND
LIVING
BRIDGE
WATERFALL
ENTRANCE
AIR COND EQUIP
MASTER BEDROOM
BATH
BEDROOM
BATH 2
BEDROOM
DRESS
HALL
STORAGE WALL
SEAT
STORAGE WALL
HEAT COLLECTING PANELS
REFLECTION POND & STORAGE TANK
SECTION
FLOOR PLAN
N
CUBAGE DIAGRAM
CUBIC FOOTAGE TOTAL TO OUTSIDE SURFACE OF ALL WALLS AND FROM FINISH FLOOR LINE INCLUDING TOTAL ROOF DECK IS 19,950 CUBIC FEET.
WEST
SOUTH


NORTHERN ELEVATION
WESTERN ELEVATION
SOLAR HEAT COLLECTOR
COPPER HEATING PIPE
SOLID 2x4'S ROOF
FURRED PLASTER
SUPERLITE BLOCK
CONCRETE SLAB
THERMOPANE
SECTION AT STUDY
REFLECTIVE ADJUSTABLE BRISE-SOLEIL
SUPPORTING RADIANT PIPE
SECTION AT BARBECUE
PRIVATE
SOCIAL
QUIET AND SUNNY
QUIET AND SHADY
ACTIVE SHADY
ACTIVE SUNNY
QUIET GARDEN
VEG.
PARKING
PLAY
FUTURE ORCHARD
SITE PLAN
N
S
TRELLIS
CHAT
STUDY
ENTRY PATIO
UTILITY
HOME SHOP
DINE
PANTRY
KITCHEN
LAUNDRY
TRASH
GIRL
T. V.
BATH
BOY
PLAY AREA
PARENTS
DRESSING
BATH
SUN BATH
PLUNGE
BARBECUE TERRACE
DRESS
SHOWER
POOL
THIS GROSS AREA TOTALS 1914 □'
FINISH ROOF LESS COLLECTOR 8.3'
8.3 x 1914 = 15900 □'
CUBAGE
SLEEPING WING FROM BARBECUE
FLOOR PLAN
BRISE-SOLEIL
TROPICAL PLANTS
ENTRY PATIO
STUDY
TALK
TRELLIS
SECTION LOOKING SOUTH TYPICAL
EASTERN ELEVATION
SOUTHERN ELEVATION

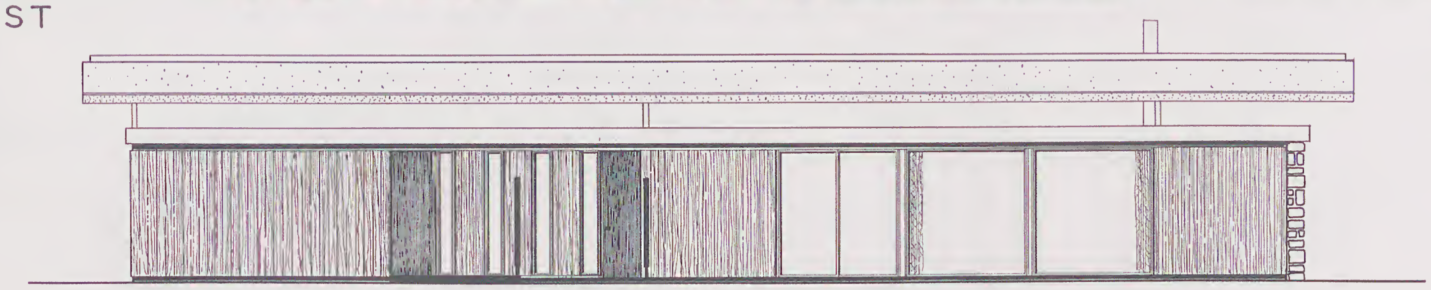

NORTH ELEVATION
SITE PLAN
POWER LINE
WATERLINE
SUNDOWN DRIVE
SHEA BOULEVARD
PERSPECTIVE FROM SOUTHEAST
PATIO
DRYING YARD
KITCHEN
DINING
LIVING
ENTRY
LAUNDRY
INSTRUMENT ROOM
MASTER BEDROOM
BATH
DRESSING
FAMILY ROOM OR MULTI-PURPOSE
BEDROOM
BEDROOM
LAWN
HOBBY
CAR PORT
SWIMMING POOL
PLAN
PLAY YARD
SOUTH ELEVATION
WEST ELEVATION
SECTION A-A
HEAT STORAGE TANK
SECTION B-B
EAST ELEVATION

KAJ SCHMIDT, Arhus, Denmark

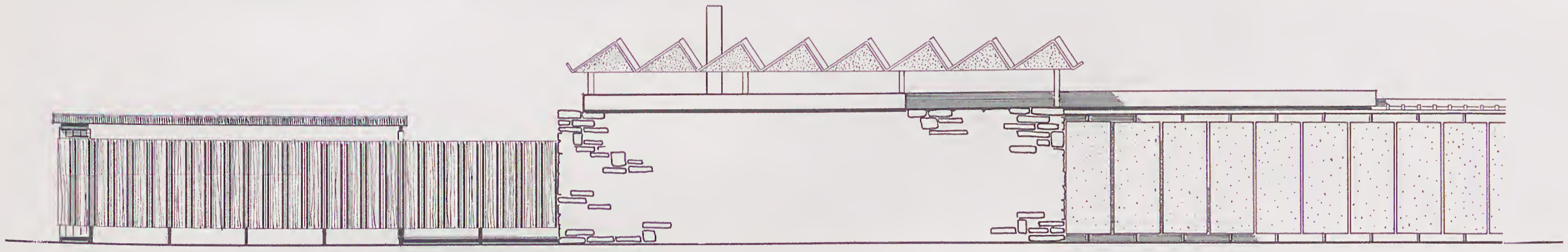




EAST

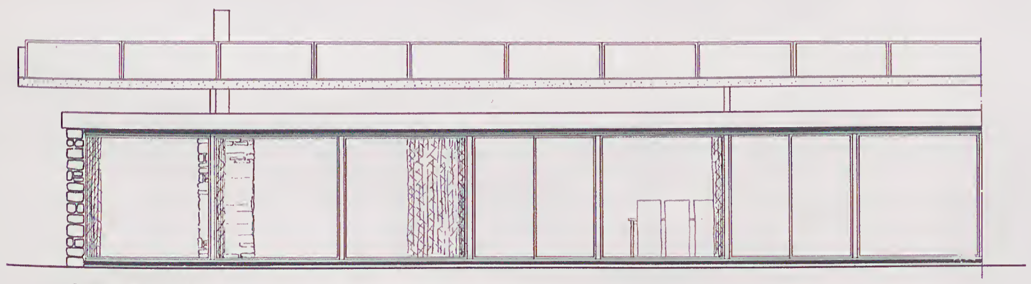


NORTH

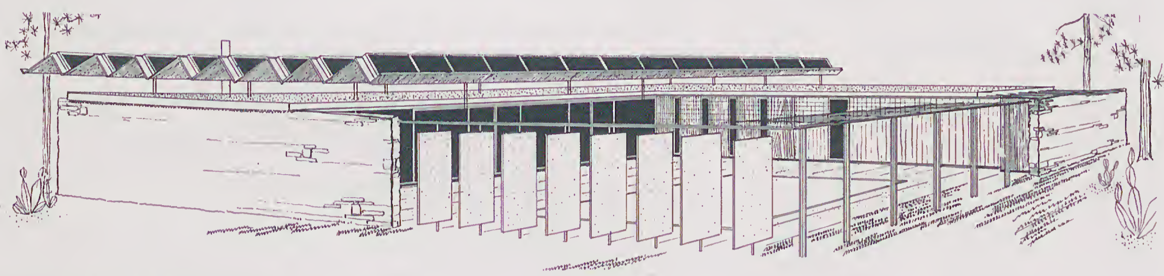


WEST

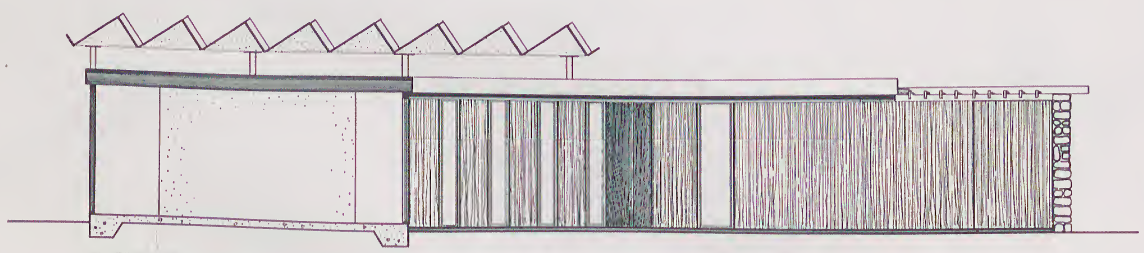
SOUTH



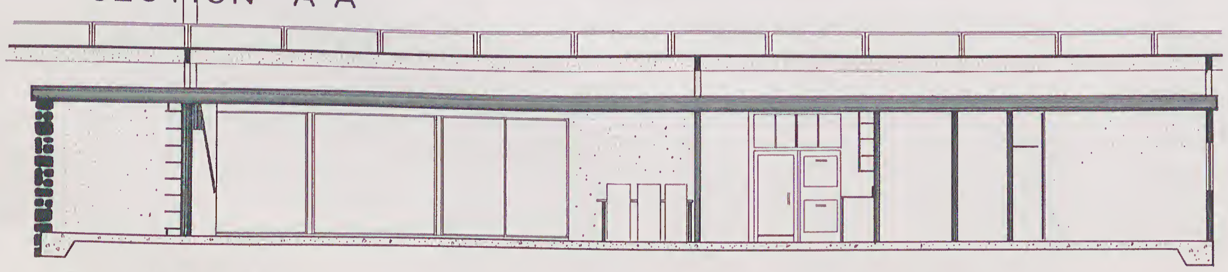
SOUTH STUDY, LIVING, DINING, KITCHEN



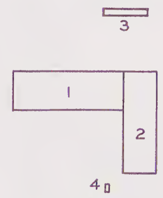
SOUTHWEST VIEW



SECTION A-A



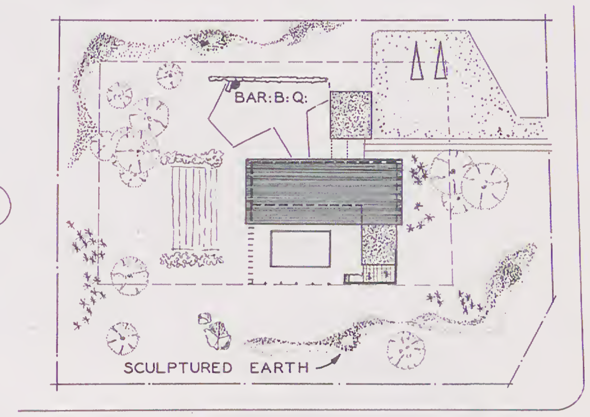
SECTION B-B



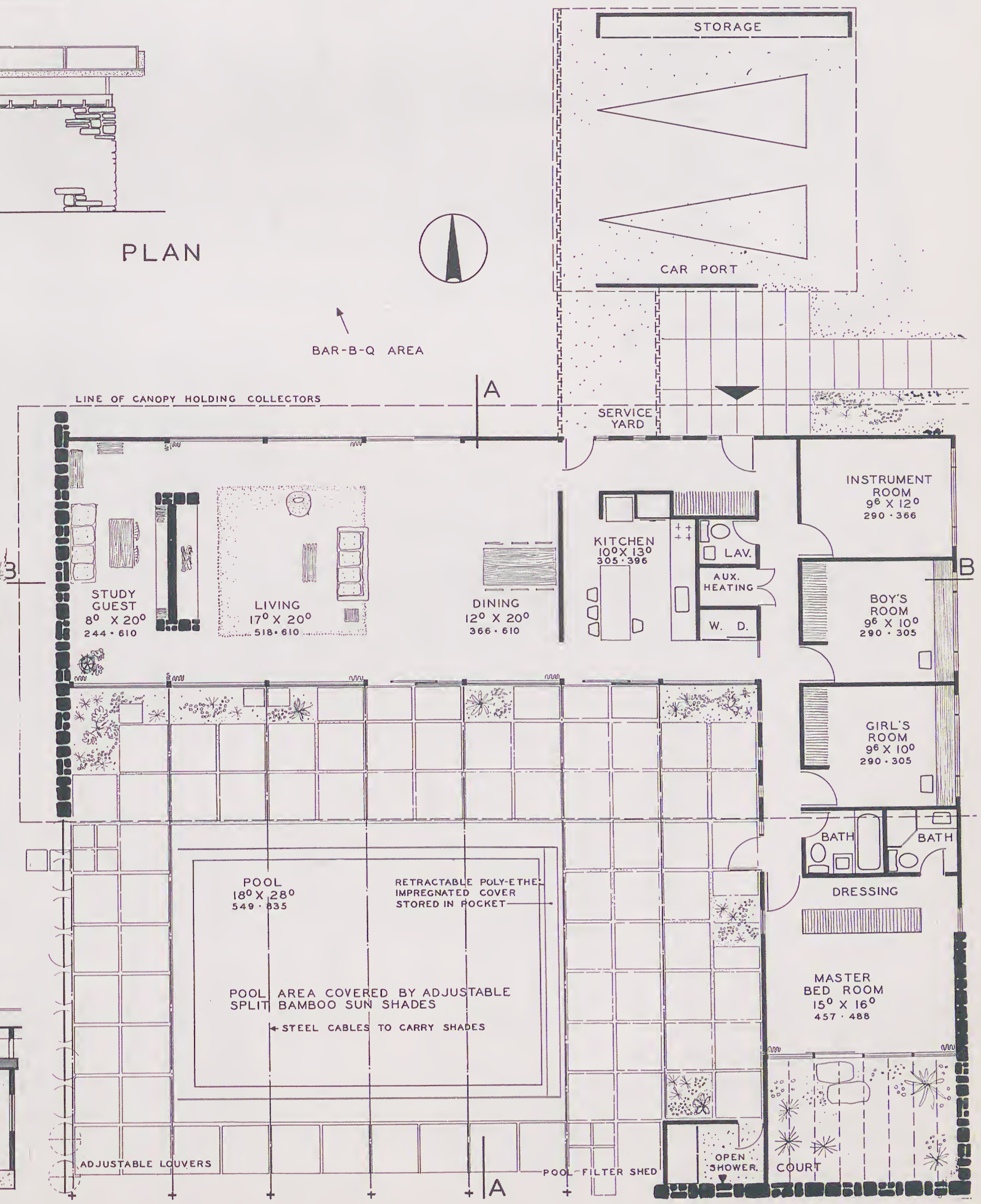
DIAGRAM

CUBIC CONTENT OF HOUSE

1 –	10,830 CU.FT.	30,600 CU. CM.
2 –	8,313	23,400
3, 4 –	388	1,070
	19 531 CU. FT.	55 070 CU. CM.

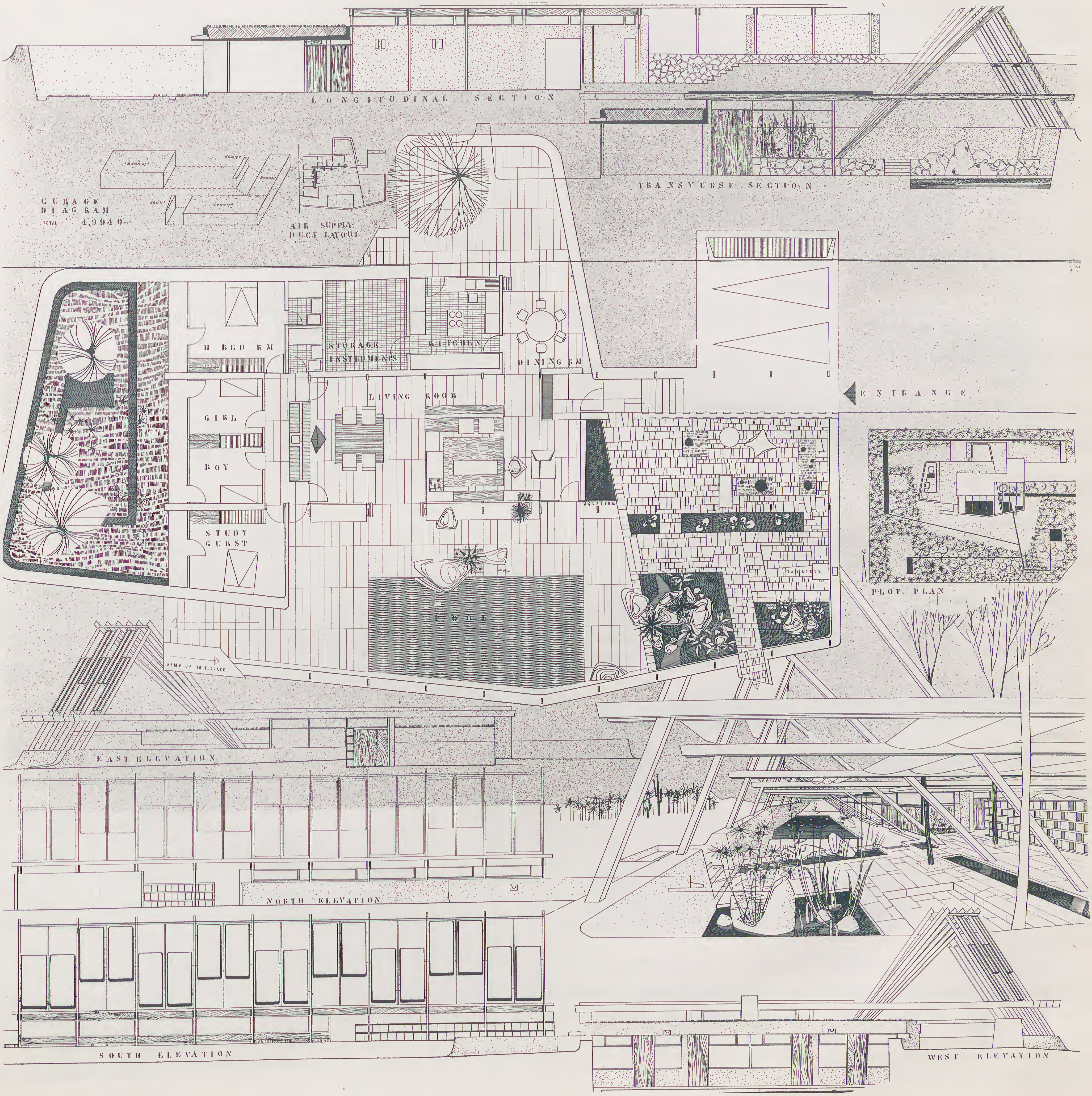


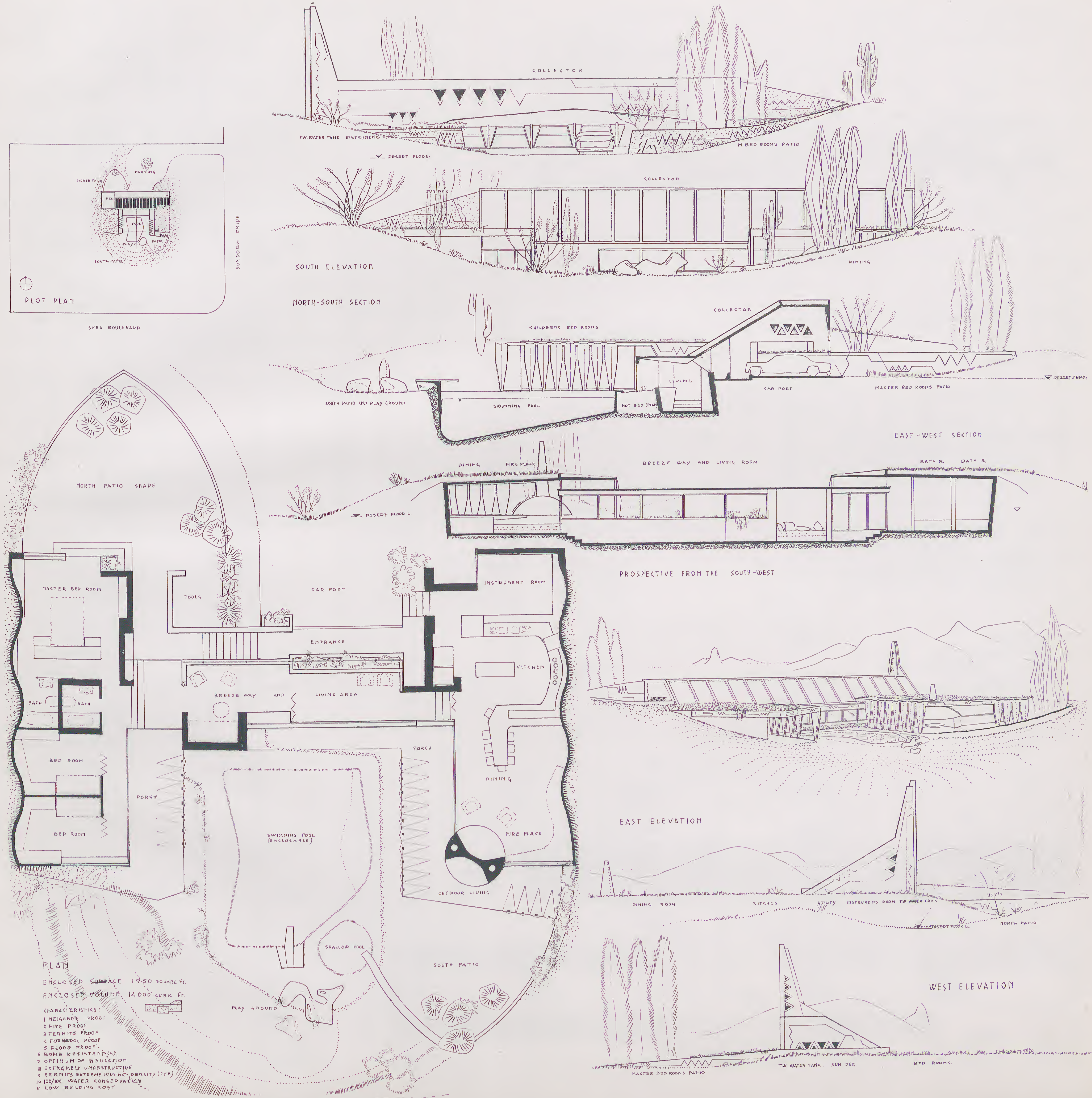
PLOT PLAN

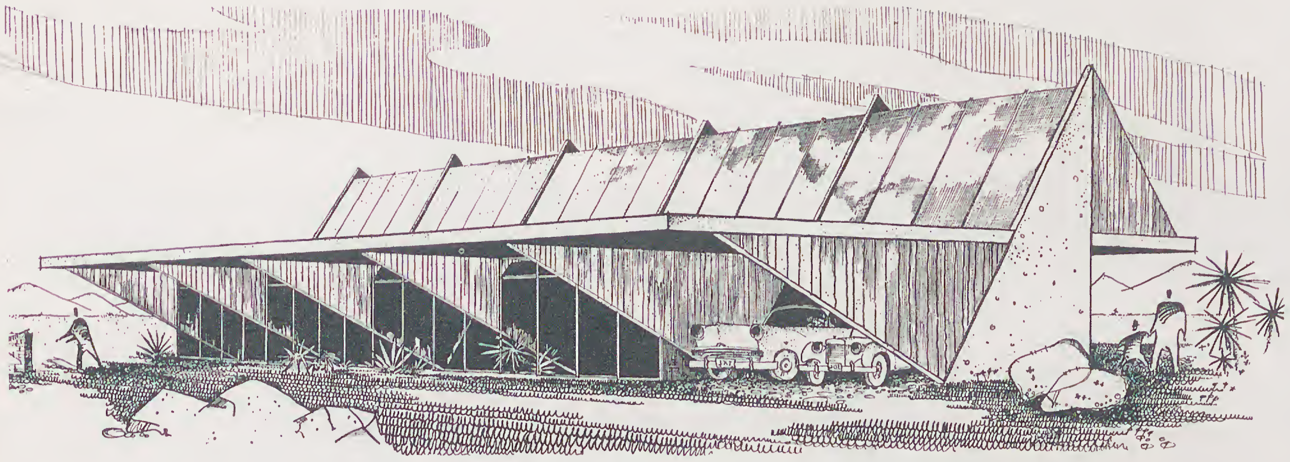


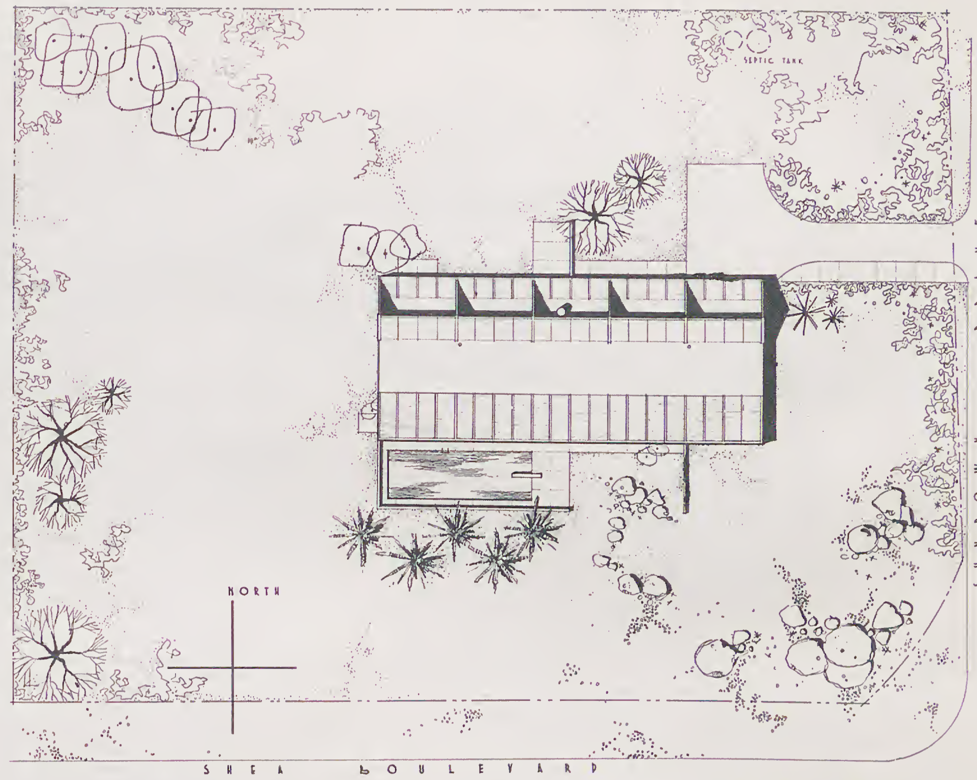
PLAN

52 GEORGE R. SERA, PIERRE CABROL, and JACQUES BINOUX, Cambridge, Mass.

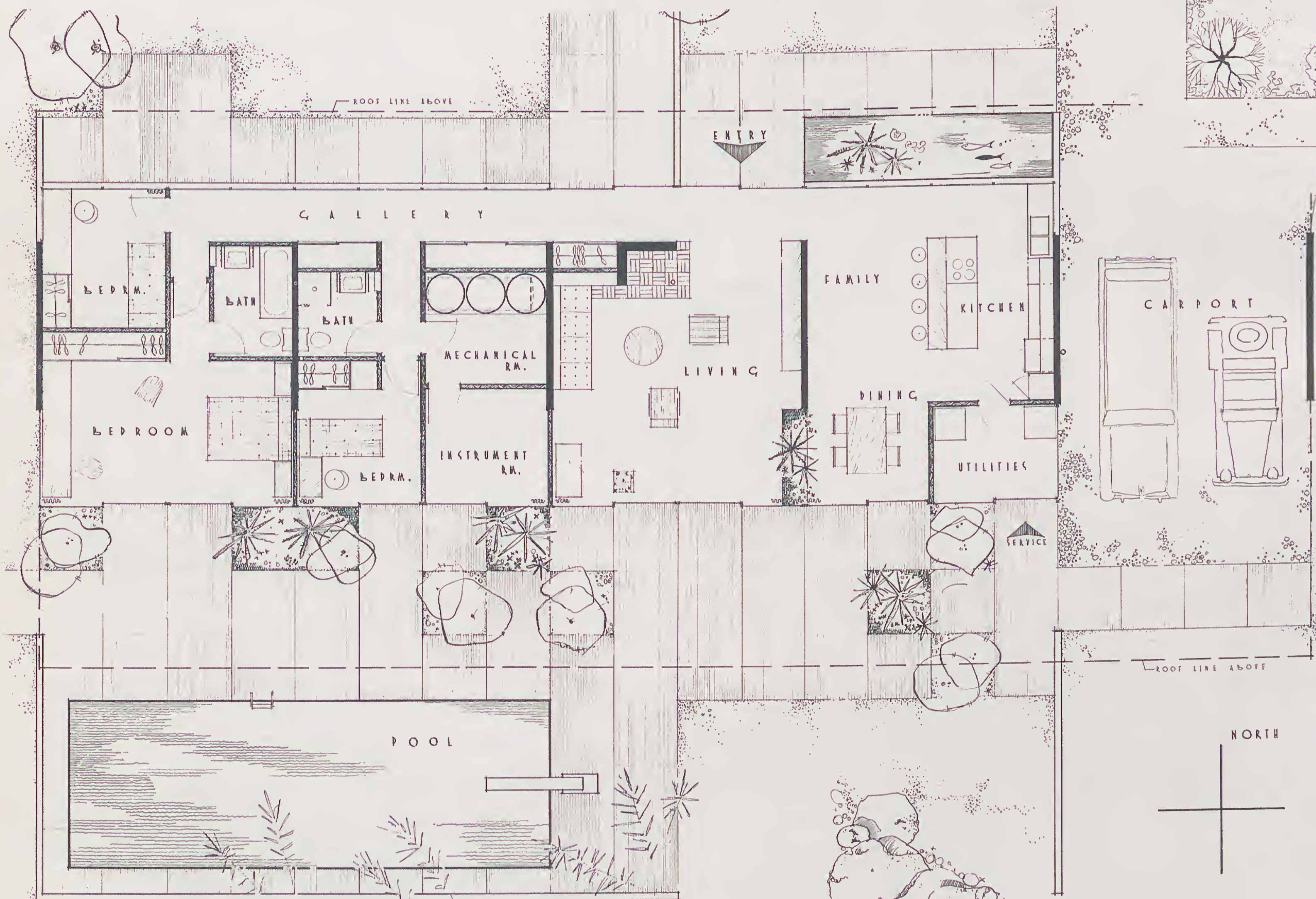



COLLECTOR
T.W. WATER TANK INSTRUMENTS
DESERT FLOOR
M. BED ROOM'S PATIO
COLLECTOR
SUN DEK
DINING
SOUTH ELEVATION
NORTH-SOUTH SECTION
PLOT PLAN
NORTH PATIO
PARKING
POOL
PATIO
PLAY G.
SOUTH PATIO
SUNDOWN DRIVE
SHEA BOULEVARD
COLLECTOR
CHILDRENS BED ROOMS
LIVING
SOUTH PATIO AND PLAY GROUND
SWIMMING POOL
HOT BED (PLAN
CAR PORT
MASTER BED ROOMS PATIO
DESERT FLOOR
EAST-WEST SECTION
DINING
FIRE PLACE
BREEZE WAY AND LIVING ROOM
BATH R.
BATH R.
DESERT FLOOR L.
PROSPECTIVE FROM THE SOUTH-WEST
NORTH PATIO SHADE
MASTER BED ROOM
TOOLS
CAR PORT
INSTRUMENT ROOM
ENTRANCE
KITCHEN
BATH
BATH
BREEZE WAY AND LIVING AREA
BED ROOM
PORCH
PORCH
DINING
BED ROOM
SWIMMING POOL (ENCLOSABLE)
FIRE PLACE
OUTDOOR LIVING
SHALLOW POOL
SOUTH PATIO
PLAY GROUND
EAST ELEVATION
DINING ROOM
KITCHEN
UTILITY
INSTRUMENS ROOM
T.W. WATER TANK
DESERT FLOOR L.
NORTH PATIO
WEST ELEVATION
MASTER BED ROOM'S PATIO
T.W. WATER TANK.
SUN DEK
BED ROOMS.
PLAN
ENCLOSED SURFACE 1950 SQUARE FT.
ENCLOSED VOLUME 14000 CUBIC FT.
CHARACTERISTICS:
1 NEIGHBOR PROOF
2 FIRE PROOF
3 TERMITE PROOF
4 TORNADO PROOF
5 FLOOD PROOF
6 BOMB RESISTENT (4)
7 OPTIMUM OF INSULATION
8 EXTREMELY UNOBSTRUCTIVE
9 PERMITS EXTREME HOUSING DENSITY (1&B)
10 100/100 WATER CONSERVATION
11 LOW BUILDING COST



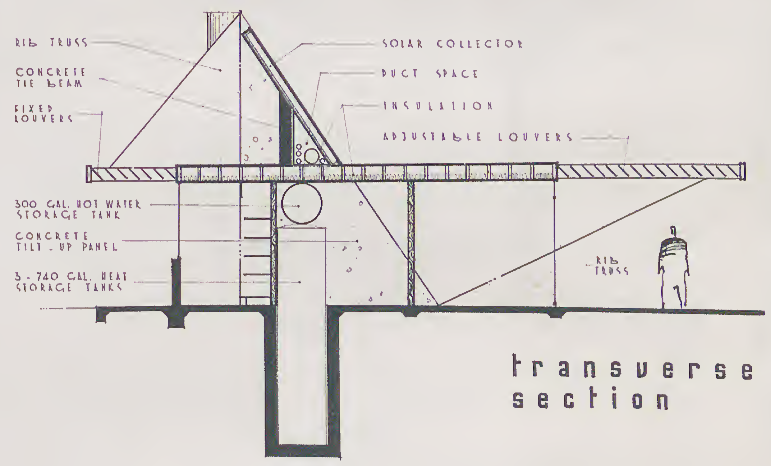


plot plan

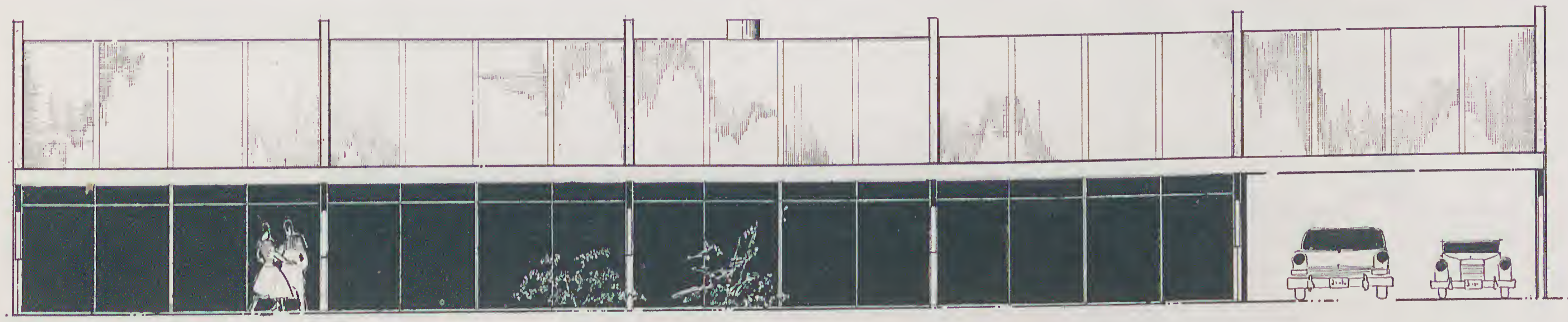


floor plan

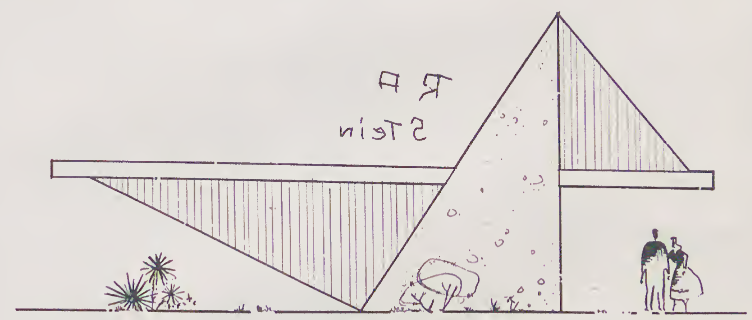
longitudinal section
broken



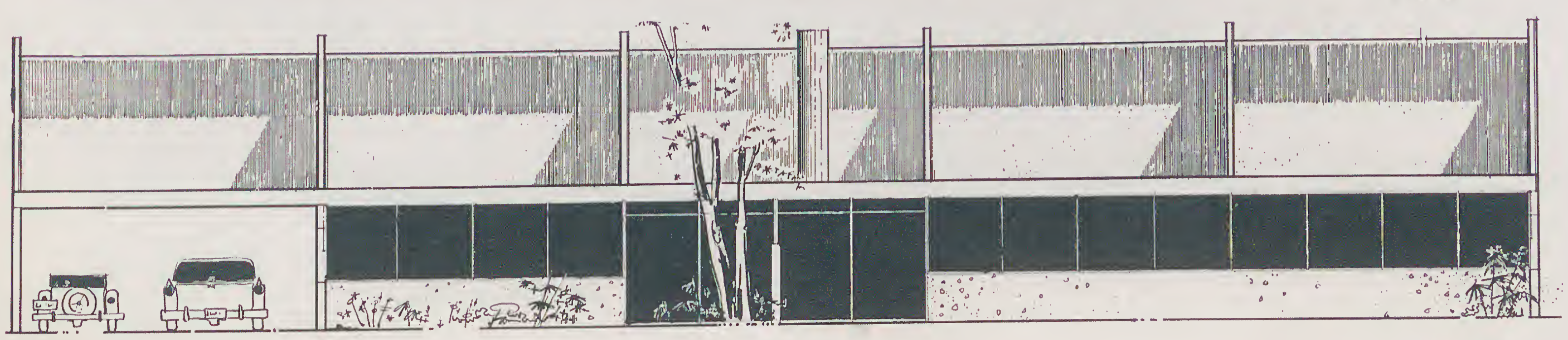
transverse section



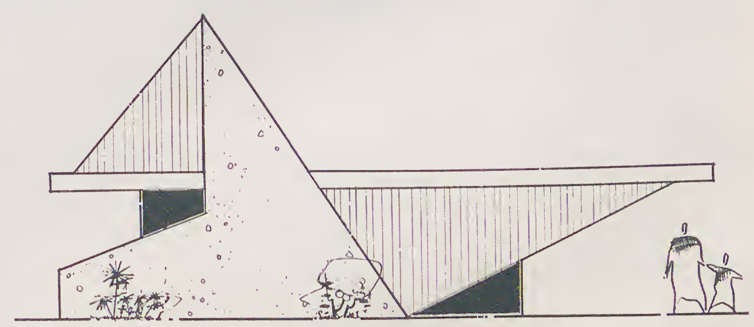
south



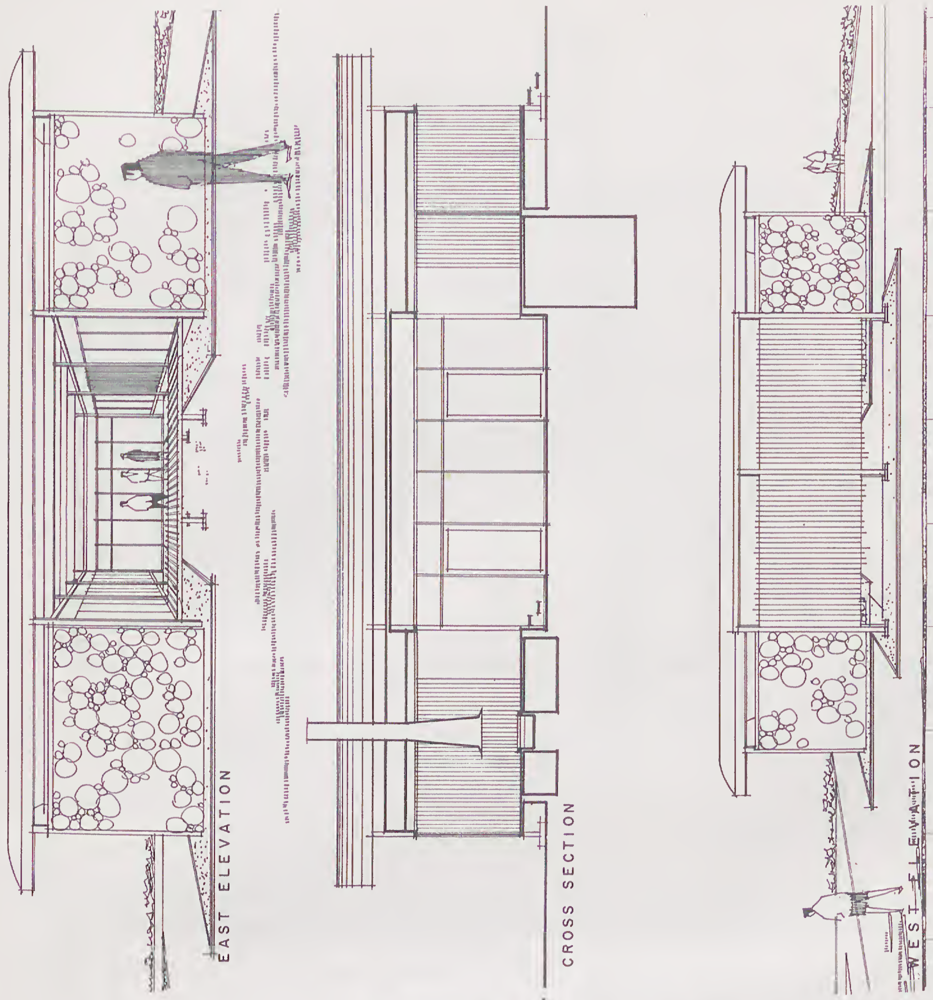
east

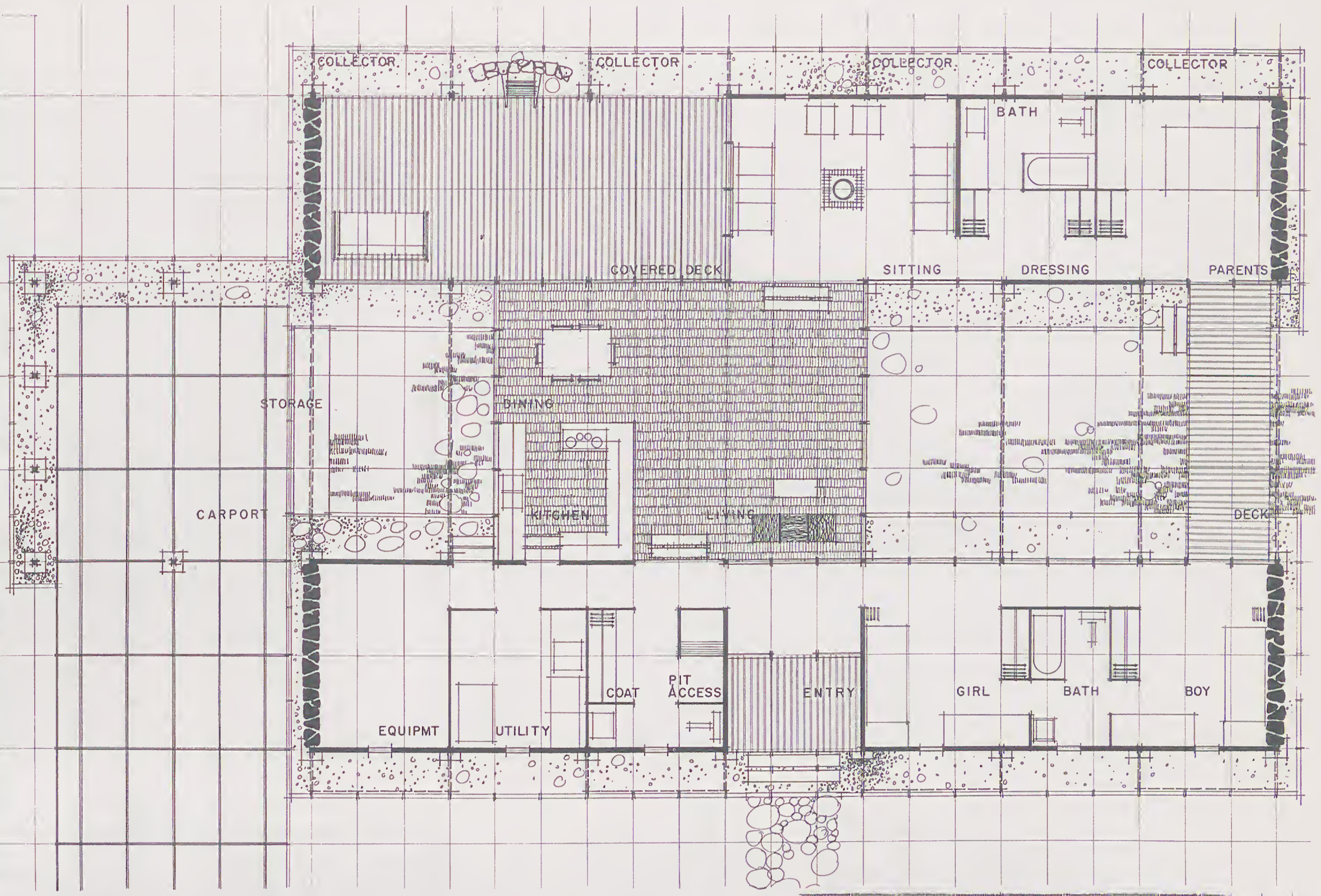


north



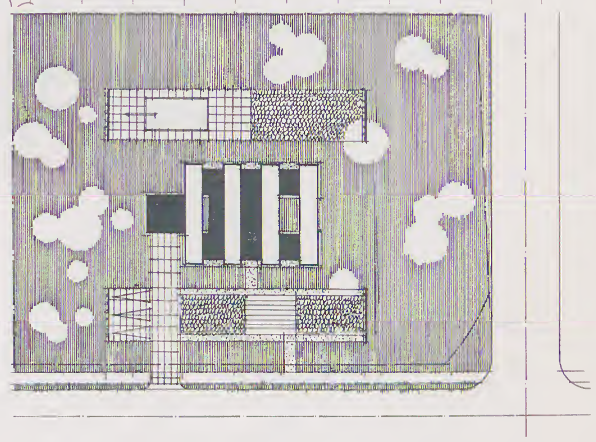
west

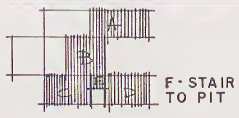


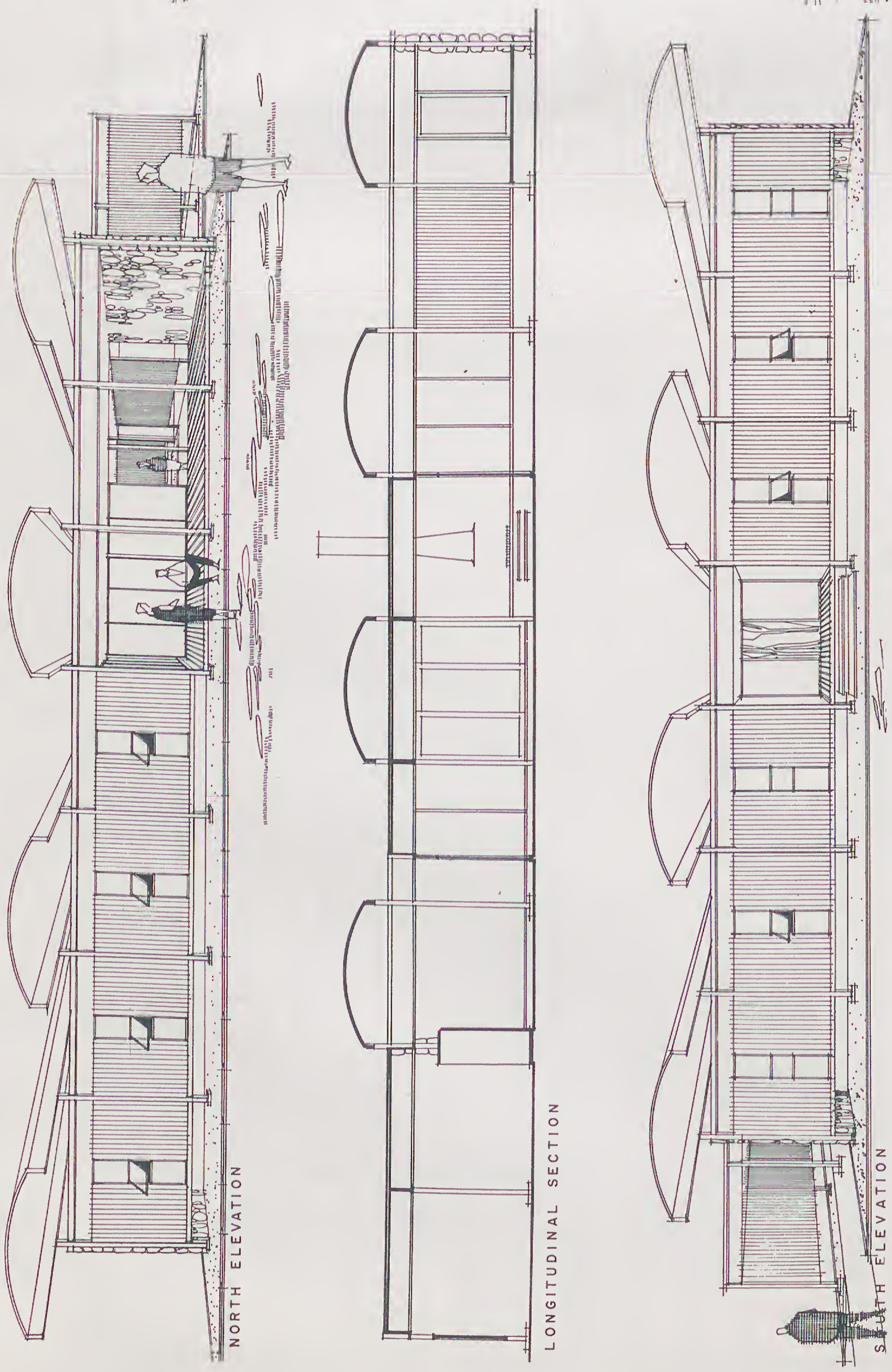


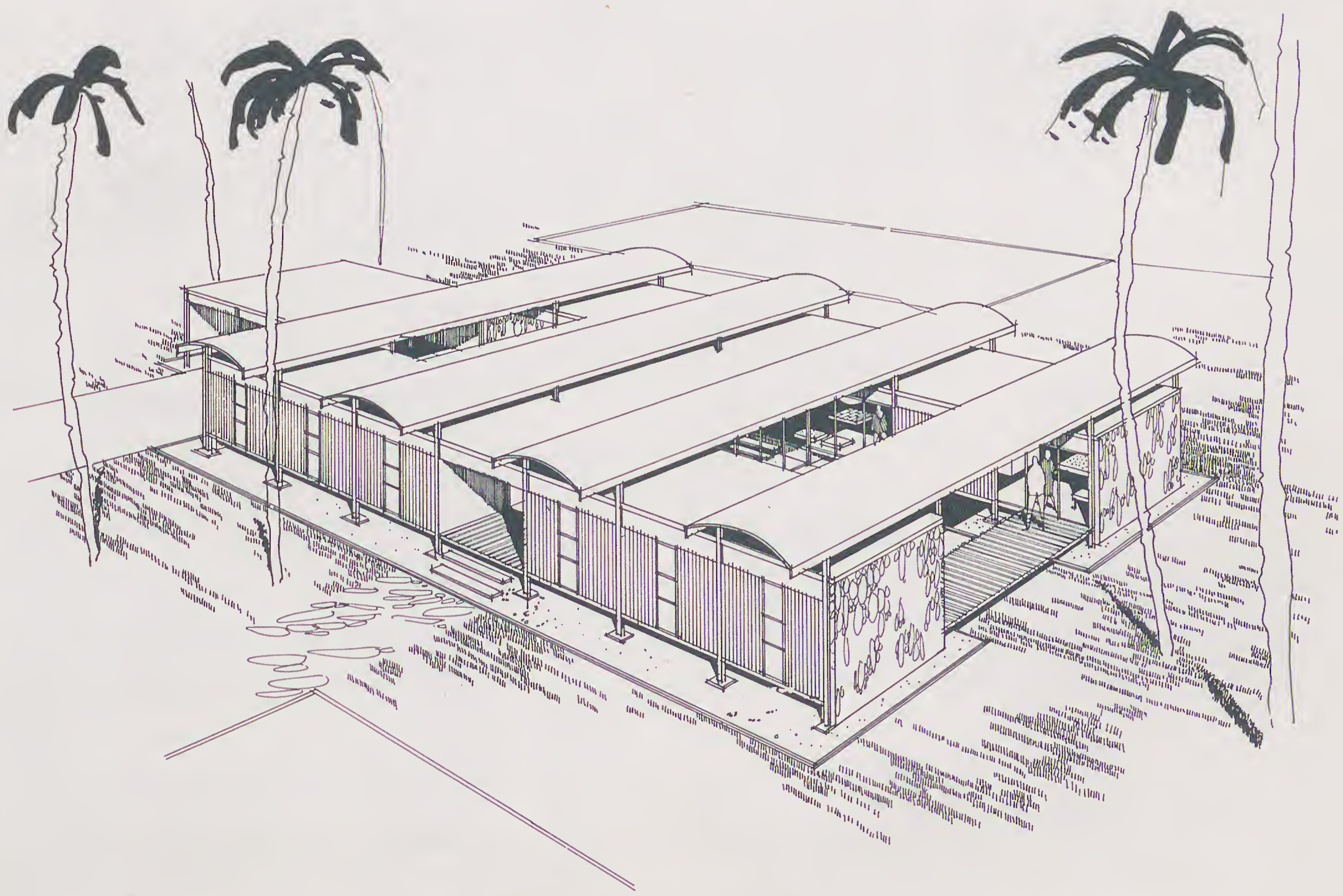
CUBAGE

A -	13.67'x 40.67' =	555.96	SQ.FT.	x	8.67'	=	4820.17 CU.FT.
B	19.88'x 27.00' =	536.76	SQ.FT.	x	10.33'	=	5544.73 CU.FT.
C	13.67'x 30.67' =	419.25	SQ.FT.	x	8.67'	=	36.34.90 CU.FT.
D	13.67'x 30.67' =	419.25	SQ.FT.	x	8.67'	=	3634.90 CU.FT.
E	7.00'x 9.67.=	67.69	SQ.FT.	x	16.67'	=	11.28.39 CU.FT.
	TOTAL SQ.FT. =	1998.91					
F	7.67'x 4.33'=	33.21	SQ.FT.	x	8.00'	=	265.68 CU.FT.
	TOTAL CU. FT.						19028.77

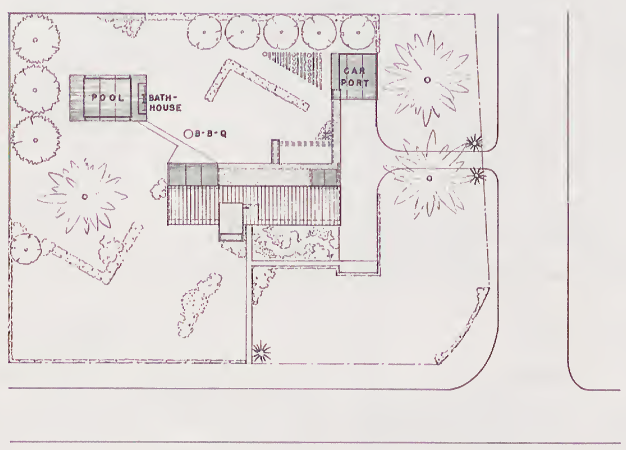


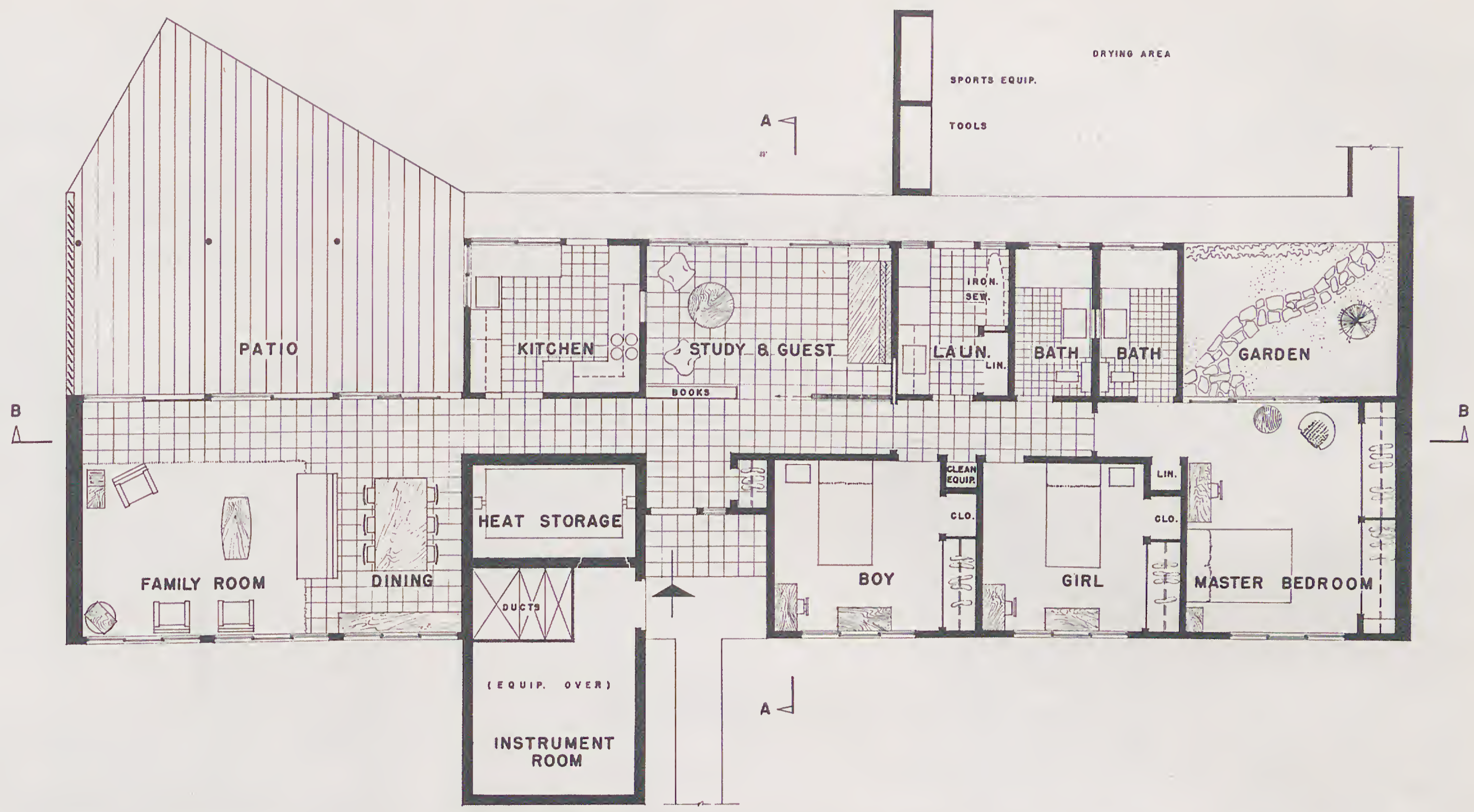


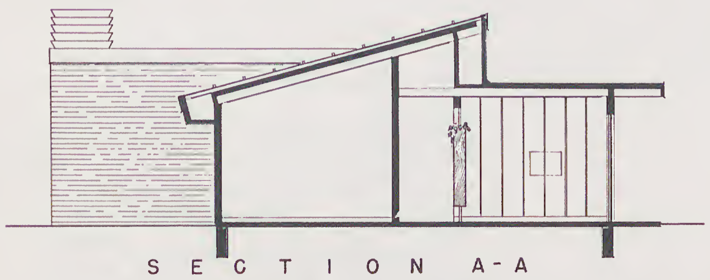




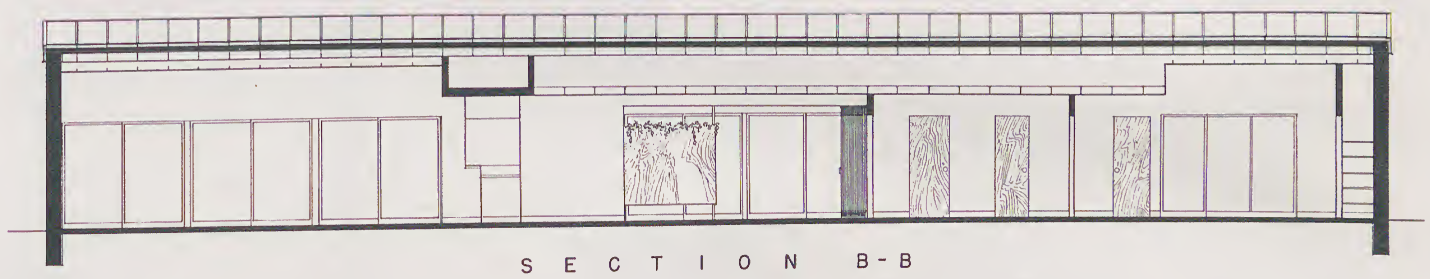
GENE E. TROTTER, Billings, Mont.



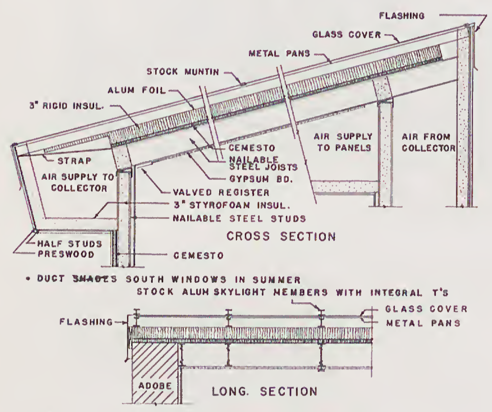




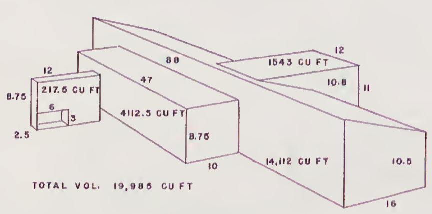
SECTION A-A



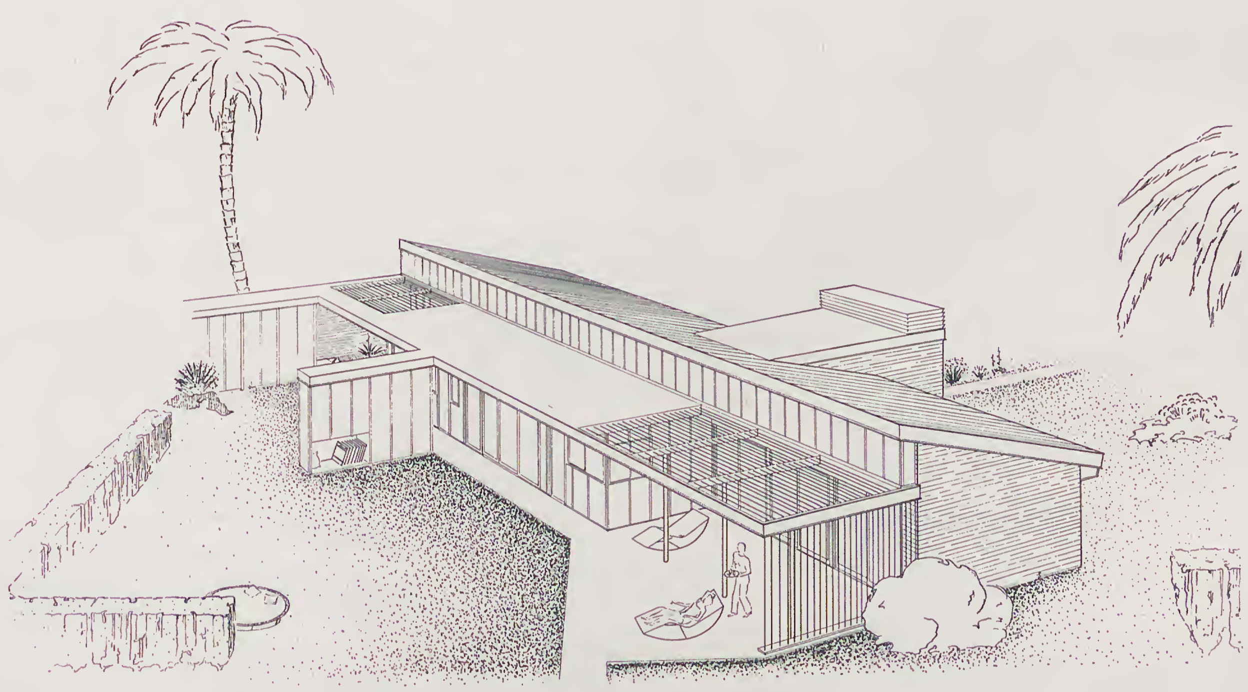
SECTION B-B

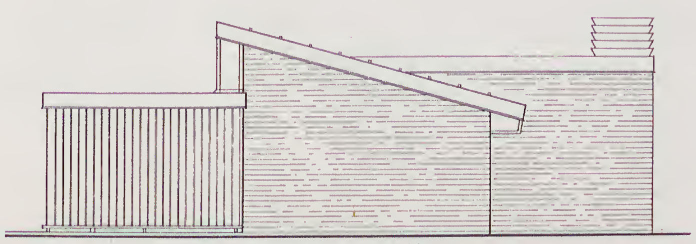


COLLECTOR DETAILS

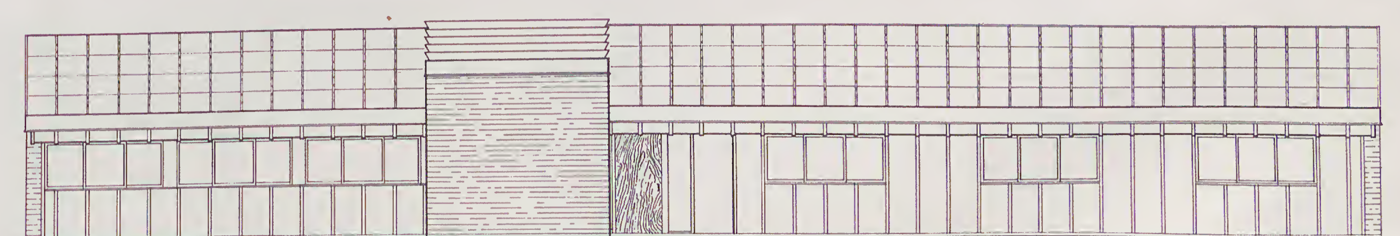


CUBAGE DIAGRAM

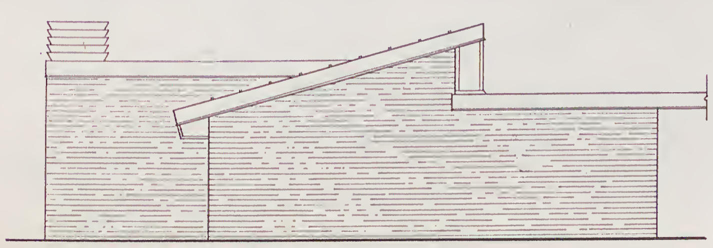




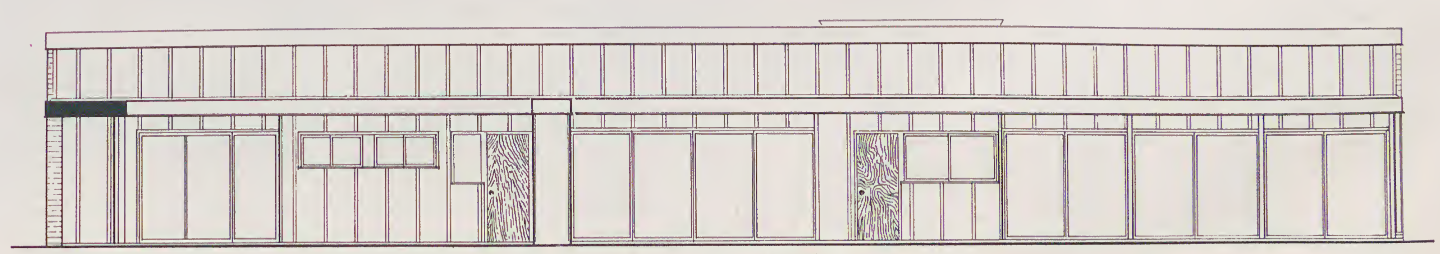
WEST



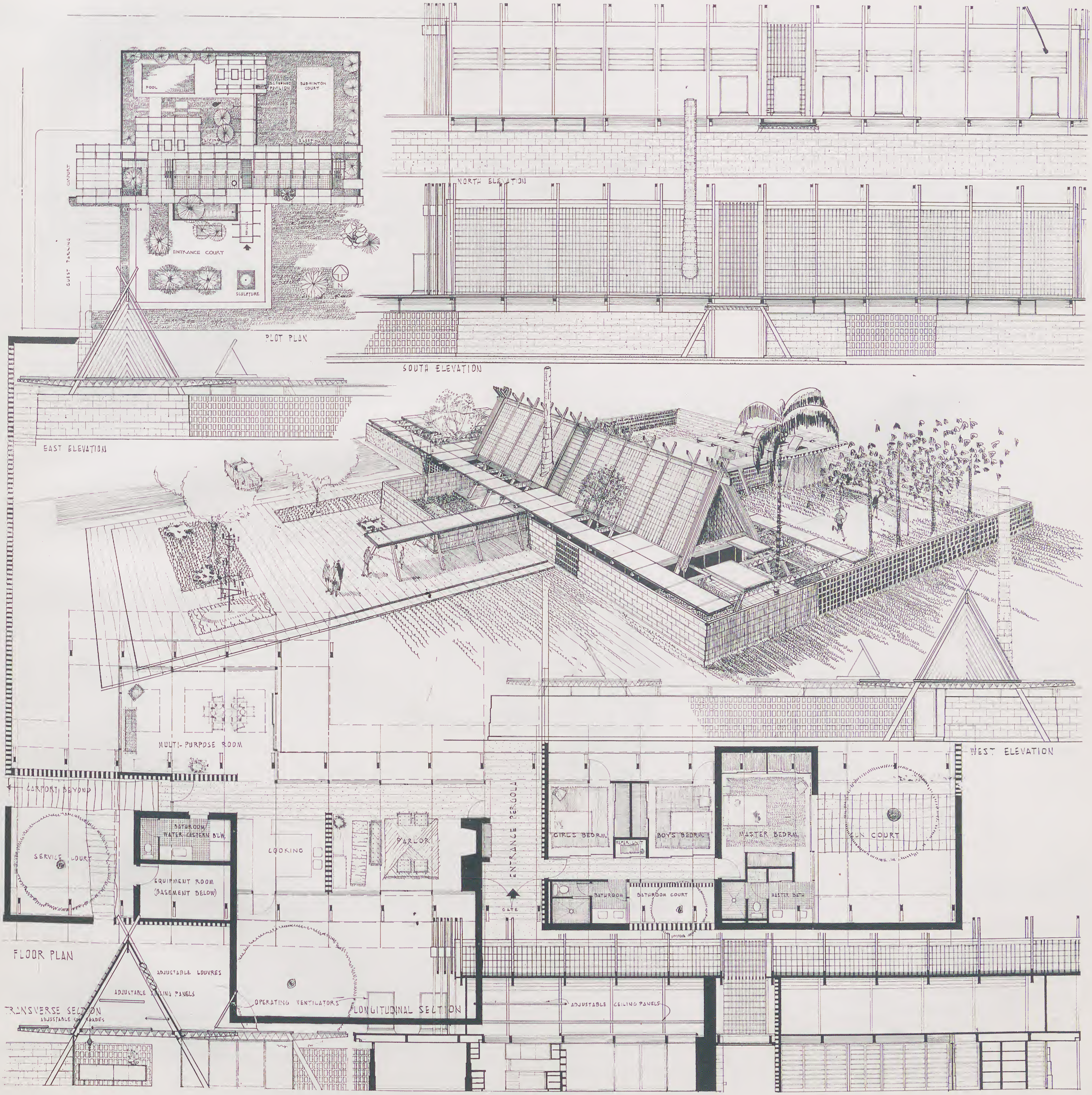
SOUTH



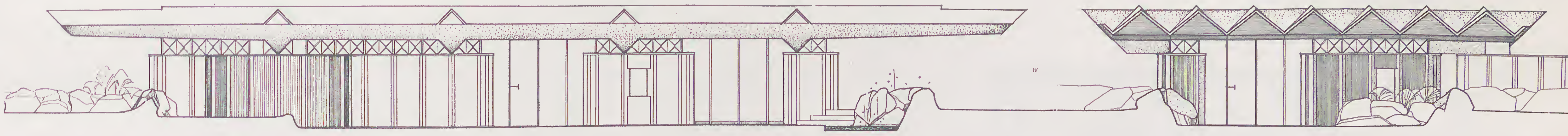
EAST



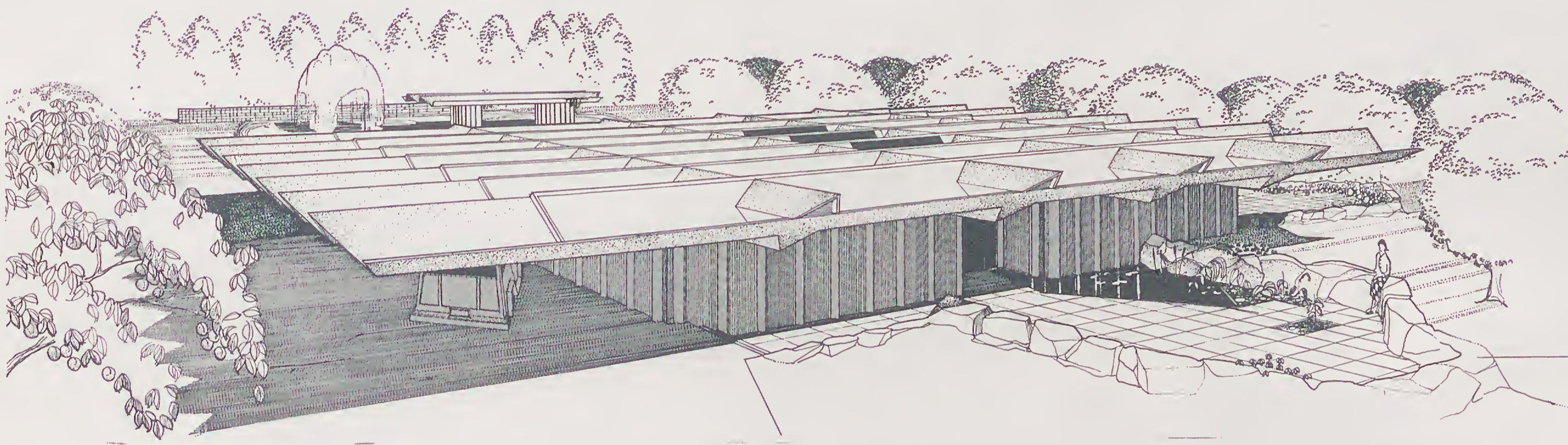
NORTH

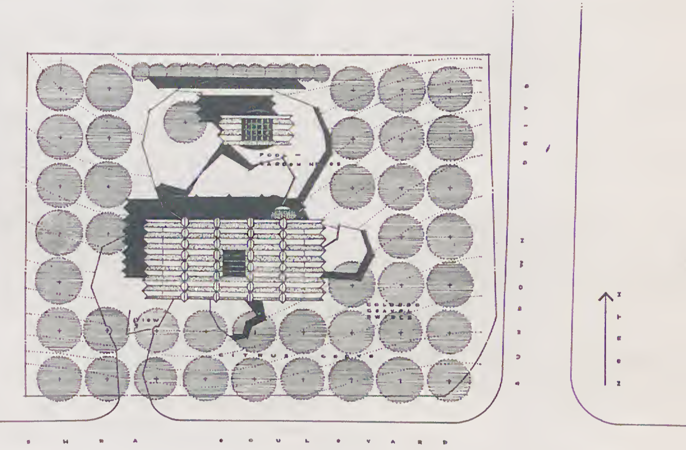

POOL
SCREENED PAVILION
BADMINTON COURT
ENTRANCE COURT
SCULPTURE
CARPORT
GUEST PARKING
PLOT PLAN
NORTH ELEVATION
SOUTH ELEVATION
EAST ELEVATION
WEST ELEVATION
MULTI-PURPOSE ROOM
CARPORT BEYOND
SERVICE COURT
BATHROOM
EQUIPMENT ROOM
(BASEMENT BELOW)
COOKING
PARLOR
ENTRANCE PERGOLA
GATE
GIRLS BEDRM.
BOYS BEDRM.
MASTER BEDRM.
SUN COURT
BATHROOM
BATHROOM COURT
MASTER BATH
FLOOR PLAN
ADJUSTABLE LOUVRES
ADJUSTABLE CEILING PANELS
TRANSVERSE SECTION
OPERATING VENTILATORS
LONGITUDINAL SECTION
ADJUSTABLE CEILING PANELS

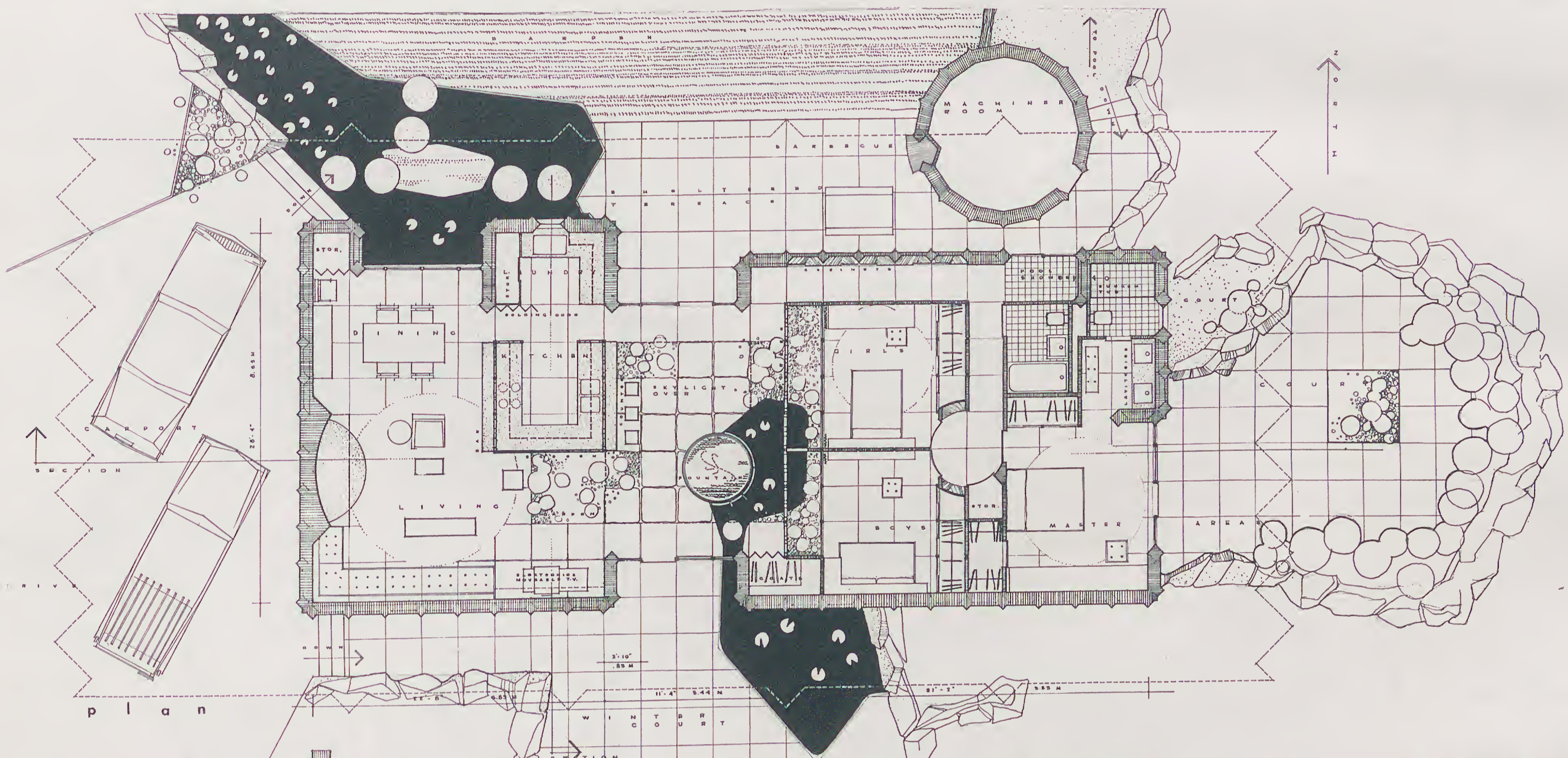
 EUGENE A. WEDELL, Eugene, Ore.



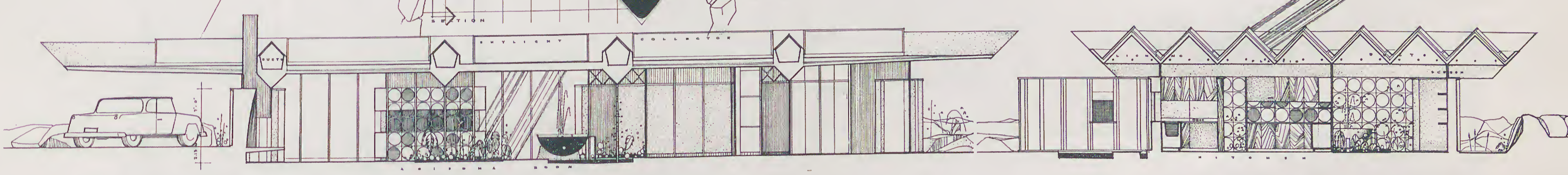
elevations



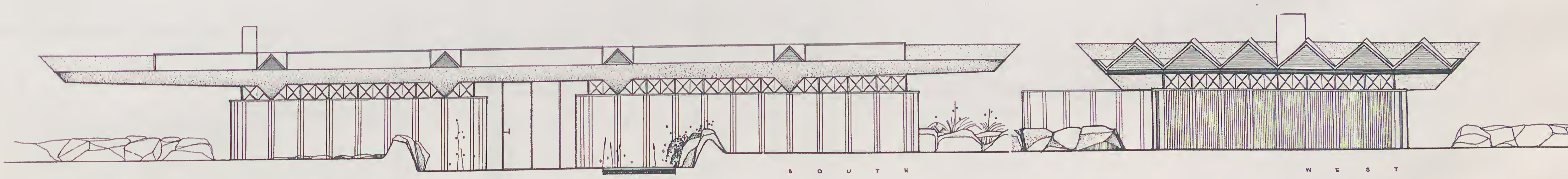




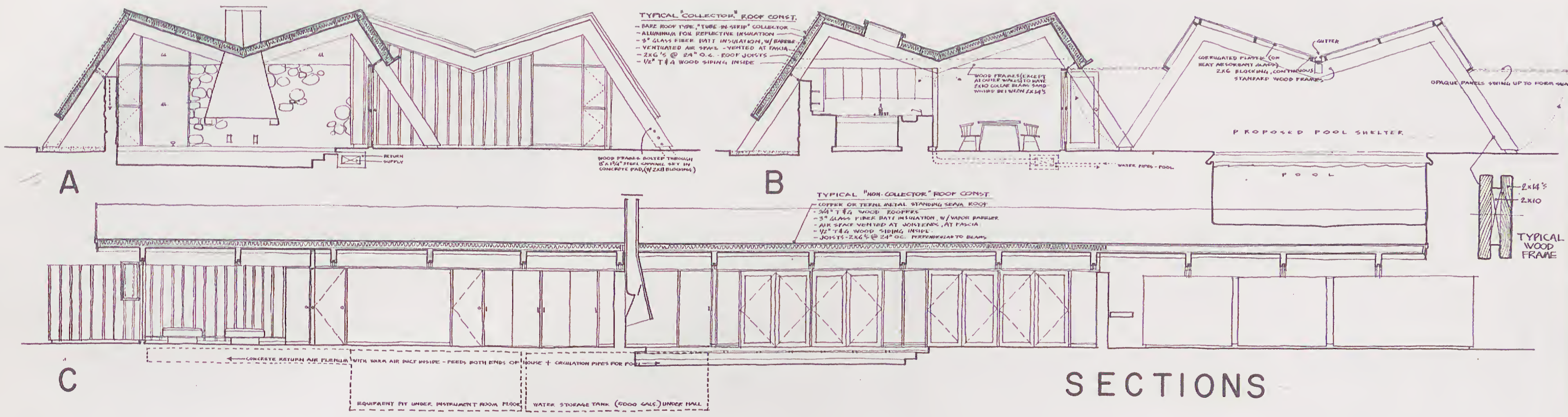
plan



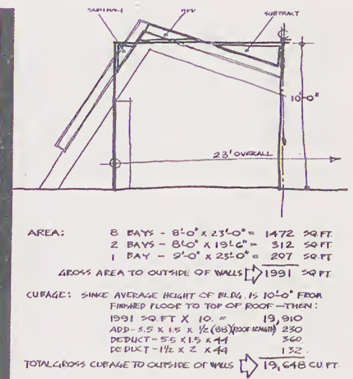
sections



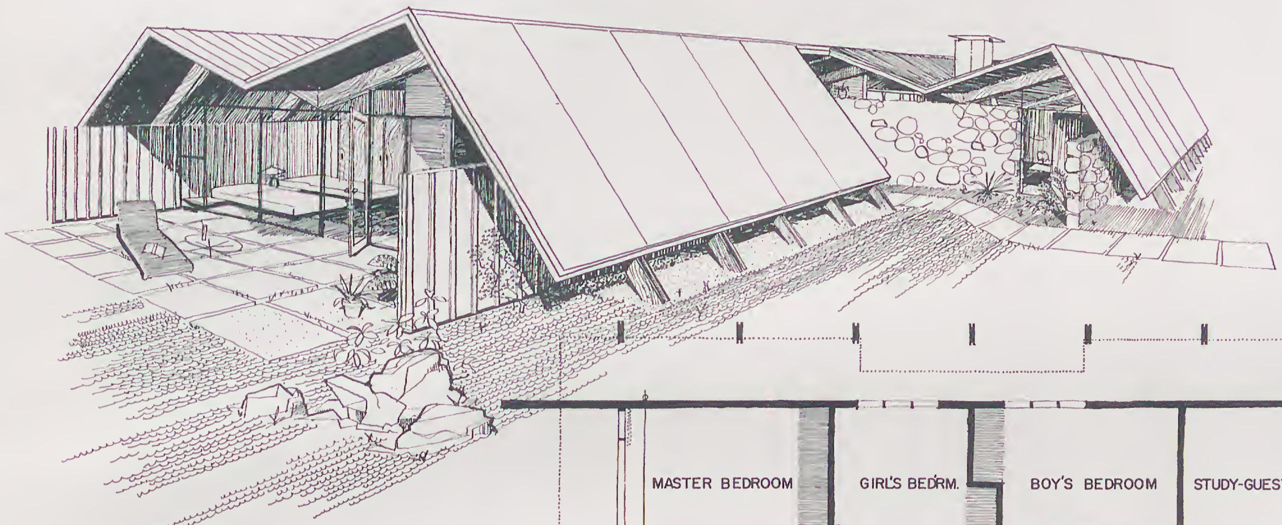
elevations



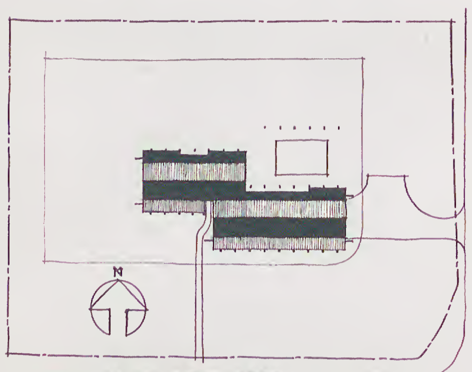
SECTIONS



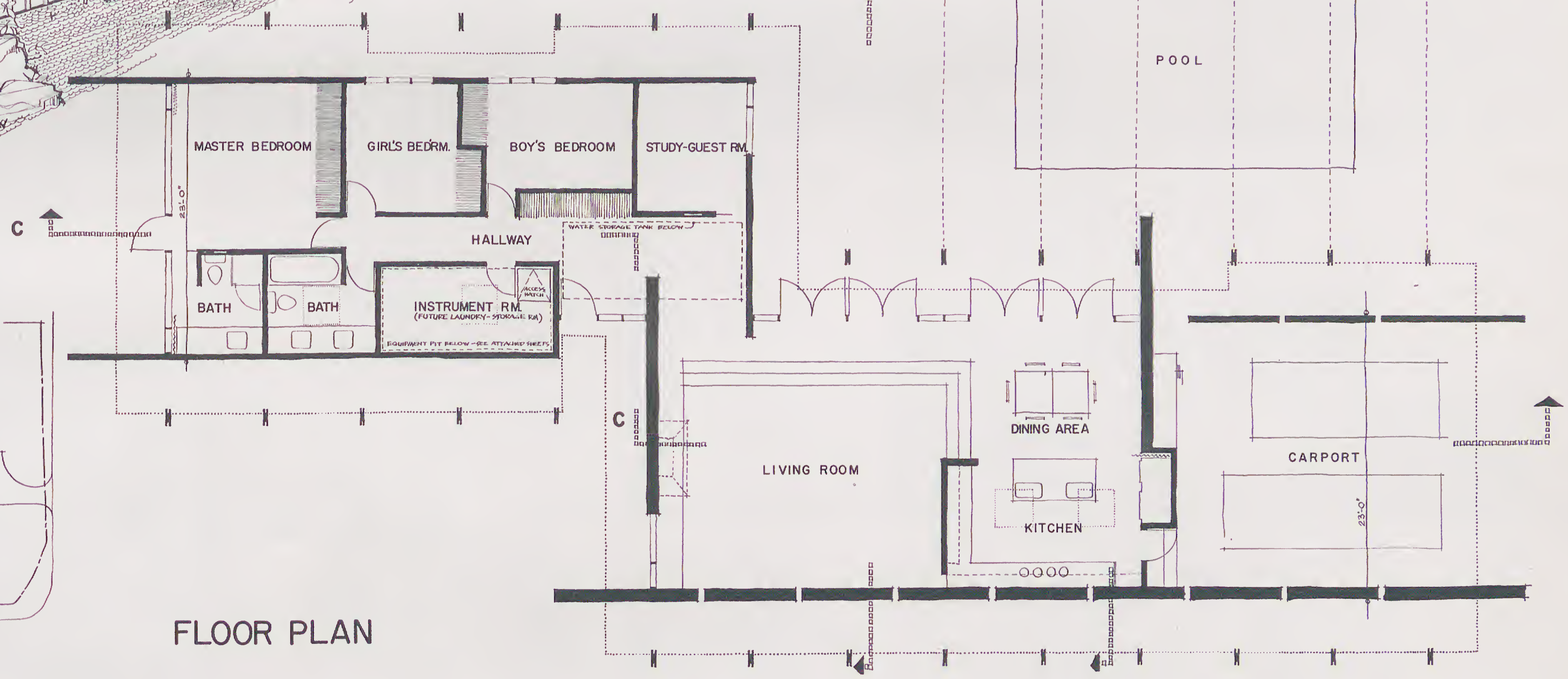
CUBAGE



PERSPECTIVE



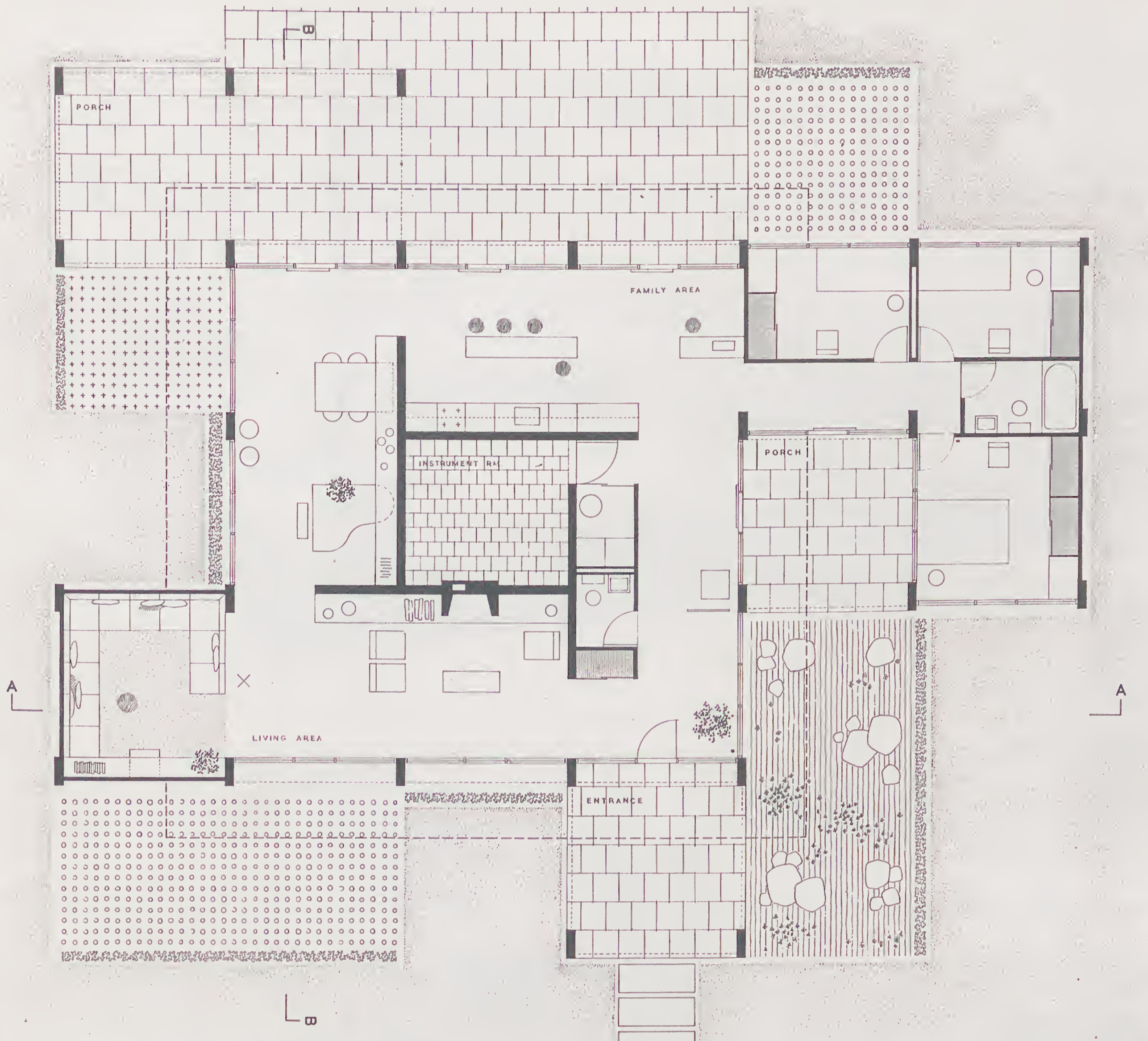
PLOT PLAN



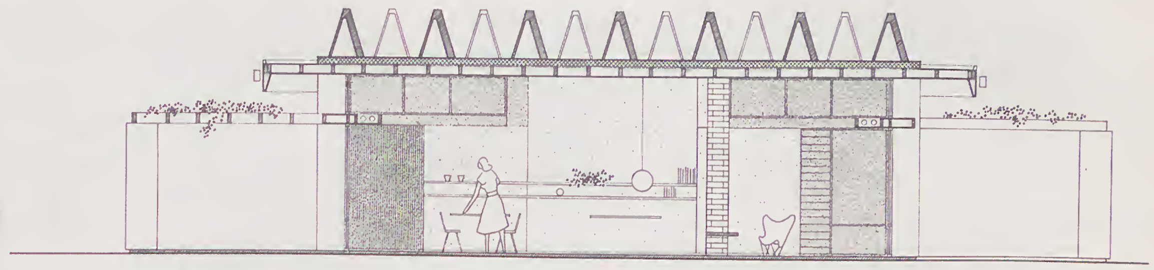
FLOOR PLAN

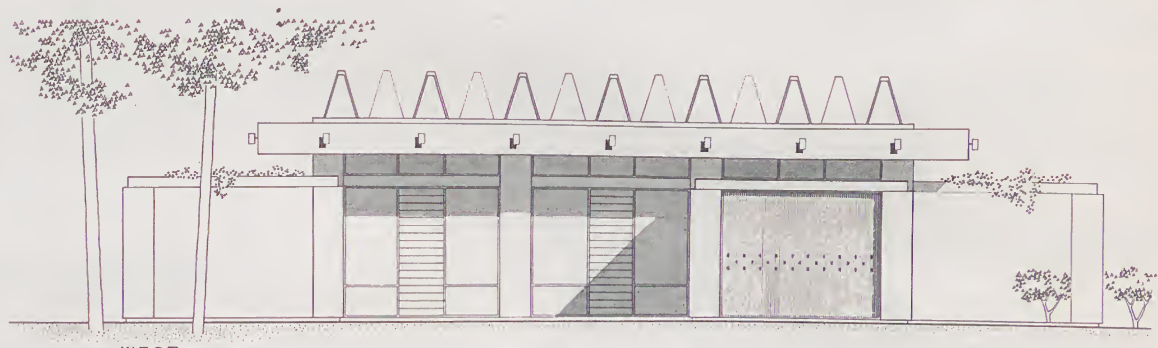
ELEVATIONS

 HANFORD YANG and JOHN N. MORPHETT, Cambridge, Mass.



PLAN


SECTION B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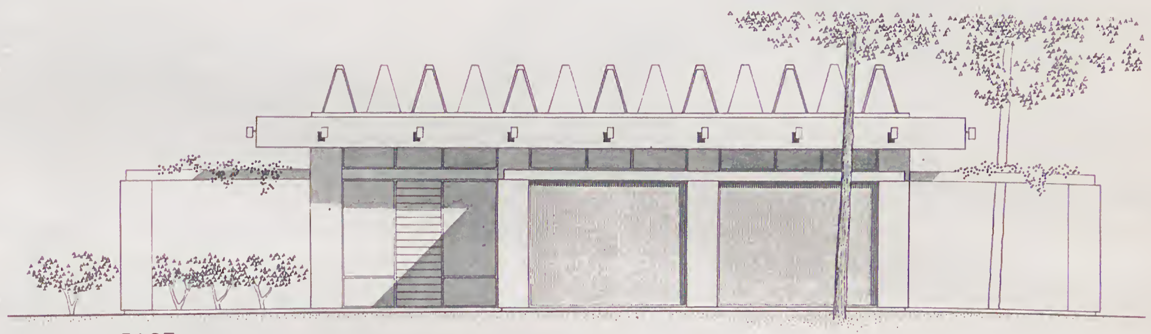
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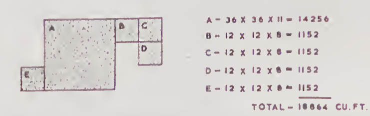

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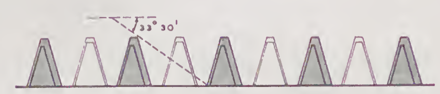
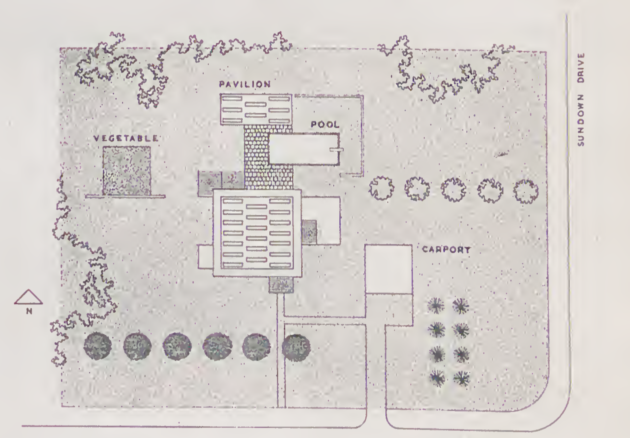


solar collector diagram



site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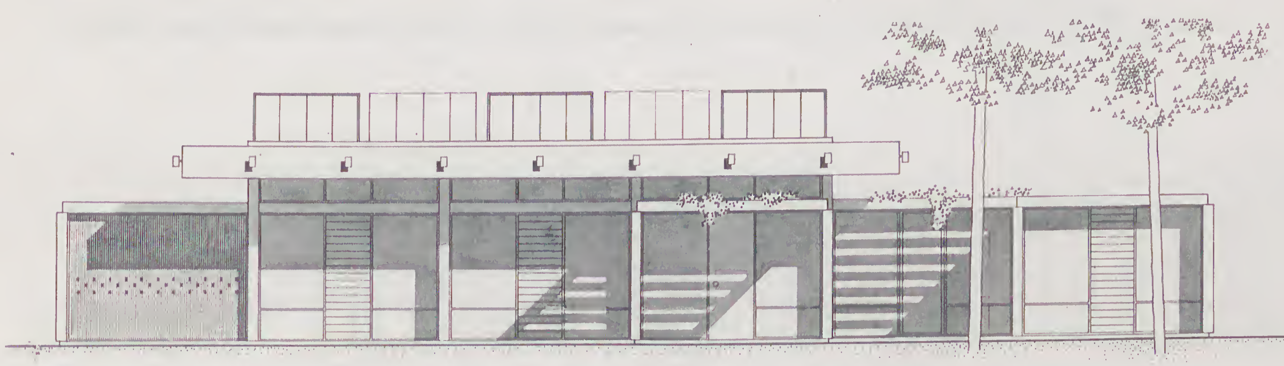
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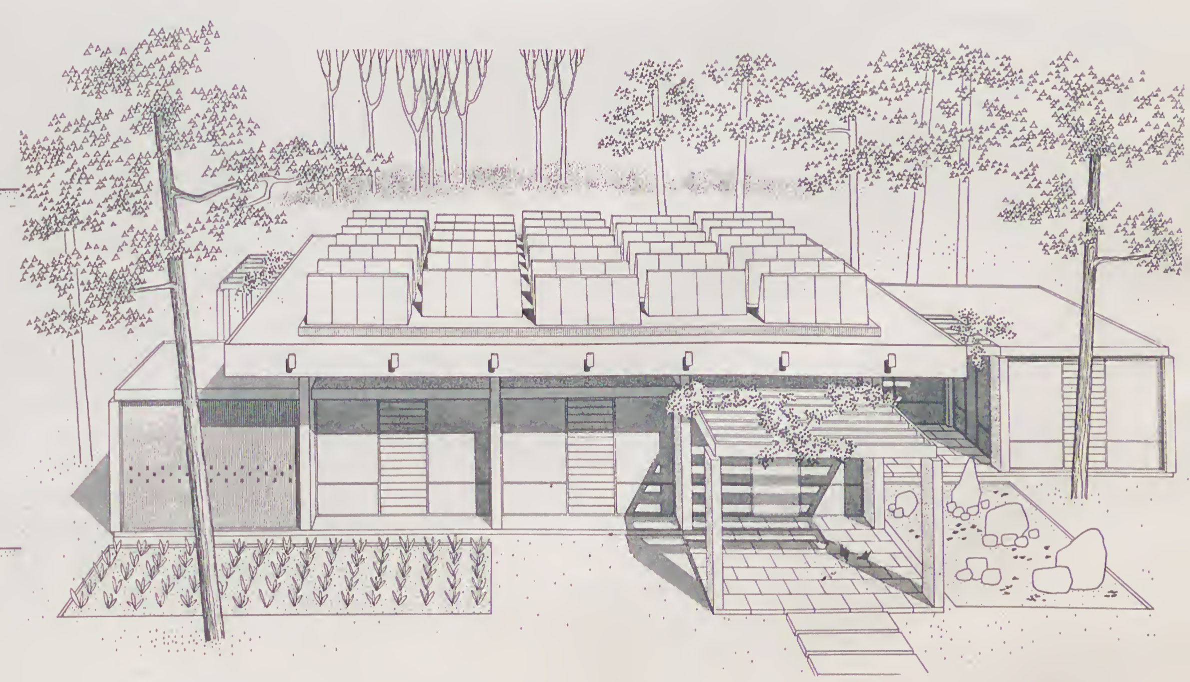
NORTH



DESIGN NOTES

The following explanatory notes on each of the preceding solar-heated house designs are based on the written notes submitted by the architect, together with the comments by the jury and by AFASE Executive Director John I. Yellott. * * *

First Prize

Peter R. Lee, *designer*..Page 1
Robert L. Bliss, *affiliated architect*
Bliss & Campbell
800 Washington Avenue S.E.
Minneapolis 14, Minn.

The louvers above the south patio, the central court, and the north patio perform the double function of collecting heat and providing shade in the summer. The domestic water supply is heated by two rows of louvers over the south patio, while the remaining louver-collectors in this group and those over the central court are used for house heating. Swimming pool heat is provided by the louver-collectors over the north patio. These are also provided with reflecting backs so that, when properly adjusted, they can reflect sunlight into the north windows during the winter, when no sunshine would normally reach this portion of the house. Heat storage is provided by a buried tank, and auxiliary heat, as well as summer cooling, by a heat pump. The roofs over the two sections of the house are made from 5-ply built-up roofing on steel deck, with 2-in. reflective insulation. The walls are specified as concrete block with air spaces, and Thermopane glass is used for the four glass walls. A plastic pool cover is also suggested. The estimated heat loss is 49,000 Btu per hour, while the estimated heat gain is 93,000 Btu per hour.

The decision on this award was reached after prolonged discussion by the jury. Among the outstanding merits of the winning entry noted by the jury were its directness and sense of unity; the logic of its solar equipment, which acts in a double capacity of shade louvers in summer and heat collectors in winter; the way in which the mechanical devices are integrated into the design; its feasibility as to cost; its livability; and, finally, the direct organization of the plan. There was criticism of the relationship of the garage and pool to the main house; these units do not compose nor do they create, by their arrangement, livable outdoor space. The podium on which the house is placed was considered to be arbitrary, adding nothing to the scheme. The entry and the main courts appear to offer a fine opportunity for creating a warm, inviting central patio, even though the drawings did not amplify this possibility.

* * *

Second Prize

Anna Campbell Bliss, *architect*..........................Page 2
Bliss & Campbell
800 Washington Avenue S.E.
Minneapolis 14, Minn.

The heating system uses bare water-circulating plate collectors, which are part of the south walls of the house, the swimming pool, and the carport. The angle of the collectors is set at 60°, and the area is 1100 sq ft. Heat storage is provided by a buried tank, and radiant panel heating is used. A heat pump provides auxiliary heat and summer cooling. Additional cooling is furnished by an air system using ducts in the truss spaces.

Specifications for the roof include 2 in. of rigid insulation of 3-in. wood decking, covered with 5-ply roofing, with white marble chips and pitch. Stucco walls with 4 in. of reflective insulation in the stud spaces are proposed. The floor is a 4-in. concrete slab with 2 in. of rigid perimeter insulation. Thermopane glass is specified. The estimated heat loss is 45,000 Btu per hour, and the estimated heat gain is 88,000 Btu per hour. A pool cover of sheet plastic, stretched between wires and used also as a drop curtain, is advocated.

The jury felt that the main appeal of this scheme lay in the fact that the solar collectors themselves produce the architectural quality of the house. The disposition of these collectors keeps the house from becoming too severe in appearance. There is a consistency of approach and a directness which the jury liked. The cost seems within reason, and the plan functions well, although its rigidity was criticized by some members of the jury. Another criticism was that the north wall slopes in the same manner as the south wall, without having the same reasons for doing so, thereby becoming a cliché rather than a logical solution.

* * *

Third Prize

John N. Morphett, *designer and architect*......Page 3
Hanford Yang, *designer*
c/o Graduate School of Architecture
Massachusetts Institute of Technology
Cambridge 39, Mass.

The heating system uses water as the transport and storage medium. The collector is composed of a large number of prefabricated units connected in rows at diagonally opposite corners. Alternate rows are staggered so that direct sunshine falls on every unit. The units face south, at an angle of 60° to the horizontal. It is proposed that the collectors use glass cover-sheets, with black copper sandwich panels through which water is forced in a diagonal pattern. Two inches of insulation is provided, with reflective metal covers on the back. The heat storage unit is located in a penthouse projecting through the roof above the instrument room. Pumping equipment, domestic hot water tank, and heat pump are located in the instrument room. Heating and cooling of the house is accomplished by air blown through floor ducts to registers at the periphery of the floor slabs. The whole collecting system is supported free of the house on a steel framework and serves as a sunshade in the summer as well as a heat collector in the winter. Heat loss is estimated at 57,255 Btu per hour, while heat gain is expected to be 35,600 Btu per hour. Total collector area provided is 1,340 sq ft, which, with 45 per cent efficiency and a normal daily insolation of 2,000 Btu per sq ft, should give the total required heat collection of 1,200,000 Btu per day.

In the opinion of the jury, the main quality achieved by this scheme is due to the solar collectors being small in scale and very appropriate for a residential character. In other words, the solar system is integrated with the architecture, and it appears to add to the attractiveness of the house, while at the same time fulfilling its purpose. The plan has some faults, but it is simple and condensed enough to be economical. Some objection was raised to the number of pieces forming the collector units, but this may turn out to be an advantage if they are mass-produced and easy to assemble.

* * *

Fourth Prize

I. C. Christensen, *architect*.................................Page 4
Rudolf Wulffsgade 14
Aarhus, Denmark
Bent Windelov, *architect*
Sylvain Thomsen, *consulting engineer*

Vertical heat collectors are placed in an east-west arrangement on the roof of the house. Water is used as the collecting medium, and heat is stored in a buried tank. Warm-water piping imbedded in the concrete under the floor-covering provides the heating element. The roof is covered with aluminum to reflect sunlight to the collectors in the winter, and to provide reflective insulation in the summer. A roof of opaque, corrugated fibreglass is provided over the swimming pool. Estimated heat loss is 41,970 Btu per hour, while the heat gain is estimated at 22,600 Btu per hour.

It is proposed that the ceiling be made of hard-pressed, perforated fibreboard, which hides the duct system for admitting cold air. Insulation is 4 in. of rock wool and aluminum foil. The 5800-gal storage tank is placed in the ground in front of the entrance, while the pumps and instruments are placed in a basement under the entry. A collector area of 720 sq ft is provided.

The jury felt that this plan has quality which is not fully brought out by the elevations and the perspective. It is a simple and very practical plan for Arizona, with a generous roof overhang and a pool which is part of the outdoor space and very suitable for informal living. The long walls seem rather arbitrary and do not add too much quality to the scheme.

* * *

Fifth Prize

Marvin E. Goody, *architect*...............................Page 5
Robert J. Pelletier
Hamilton and Goody
238 Main Street
Cambridge 42, Mass.

The conservation of energy for both heating and cooling is the key to many of the design features of this house. The heavy masonry walls which greatly increase the heat capacity of the structure have been buried, wherever possible, to utilize the ideal earth temperatures which exist the year round a few feet below the surface (72°). The solar collector and the weather roof float above the insulated ceiling structure, providing heat and ventilation in the winter and, with the louvers closed in the summer, an insulating air space. Twelve hundred square feet of heating collectors are provided in the form of insulated panels, 6 ft long. The 5000-gal capacity storage tank is constructed from 10-ft diameter, precast concrete pipe section, with the ends sealed and the tank lined with foamed glass insulation. The tank is buried in the ground outside the equipment room, since it is not economic to include the tank within the house envelope. Auxiliary heating and summer cooling are provided by a heat pump, which uses the storage tank as its heat source, thus increasing the efficiency of both heat pump and solar collector. A small tank, of 100- to 200-gal capacity, is maintained at a temperature sufficient to carry the entire heating load and also to provide final heating and domestic hot water. Heat disposition is by warmed and cooled air in a system of ducts, with each wing of the house being provided with a heat exchanger and blower. Total heat loss is expected to be 53,626 Btu, while heat gain at the design conditions is 55,656 Btu per hour.

This entry produced lively discussion among the jury members. Some of them objected to the fact that the house was sunk into the ground while others admired this very idea. The fact that much of the outside walls is below grade makes for an evening-up of the temperatures; under proper hands, this modulation of the earth around the house could become an attractive feature. There was some question about bedrooms receiving enough light and whether the roof would look rather strange to the neighbors. There will always be controversy on a house of this kind since obviously it is inward-looking and therefore may appeal only to certain types of clients.

* * *

Honorable Mention

Morton Karp, *designer*..Page 6
De Silva Island
Mill Valley, Calif.
Beland & Gianelli, *affiliated architects*

The collector consists of a plastic cover over a blackened and corrugated metal plate, with the back insulated and supported by an earth-berm. The transfer medium is water, and storage is provided by a tank below the swimming pool. The intent is to utilize the pool as insulation and to take advantage of the tank heat loss. A "hot-pit," consisting of a sloped bed covered with reflective aggregate, is provided in front of the collector to increase the pickup of heat. Heating of the building and the pool is by means of radiant panels, with auxiliary heat and summer cooling supplied by a heat pump. The double roof is provided with dampers, so that the air space will act as insulation in the winter and provide cooling in the summer. Winter heat loss is expected to be 41,000 Btu per hour, while summer heat gain in the design conditions will be 49,000 Btu per hour. The double roof, combined with an aluminum surface, is expected to minimize summer heat pickup.

The jury admired the skill with which this house is set on the site and the fact that the sloping, insulated roof provides excellent ventilation in Arizona's summer climate. The plan seems a little too belabored, and the corridor long and dark.

* * *

Honorable Mention

Enis Kortan, *architect*..Page 7
c/o Marcel Breuer
201 East 57th Street
New York 22, N.Y.

The solar energy collector, of the water-heating type, is mounted on a separate structure which is located at the north side of the pool court. Heating will be accomplished by radiant front panels. Estimated heat loss, based on 32° outside temperature, is 43,000 Btu per hour, while the estimated maximum summer heat gain is 38,000 Btu per hour. Energy storage is provided by tanks placed in the rear of the carport.

This plan was thought by the jury to be worthy of mention because of the strong statement made by the solar-collecting devices, although it was felt that such a feature should perhaps be even more sculptural than indicated. Also, it was felt that the scheme would be more suitable for a northern climate because the wall behind the pool and the paving around the pool would absorb great quantities of heat during the summertime. The plan is good and logical, although somewhat too rigid.

* * *

Honorable Mention

Richard B. Maides, *architect*..............................Page 8
Gerald J. Shaw
232 Delaware Avenue
Buffalo, N.Y.

Continuous aluminum collectors are proposed, faced at the optimum angle across the south elevation of the building. The panels are supported by metal struts attached to the rafters. Openings between the rows shield the interior from direct sunlight and allow heat from the porch to escape. The domestic hot water is taken from the main supply system by means of a heat exchanger. The storage tank, of 90- to 100-gal capacity, is equipped with two immersion heaters to maintain an increased temperature of 140°F. The heat storage is supplied by an insulated tank of 6,000-gal capacity. The estimated heat loss, with 300 sq ft of glass, is expected to be 47,700 Btu per hour, and the heat gain is expected to be 56,000 Btu per hour.

The jury commented that the design was commendable for its compactness and simplicity, although there was some objection to the fact that the solar collectors run the whole length of the house. It was suggested that the angle of the south-sloping roof would have been sufficient to support the collectors directly, thus eliminating technical and structural difficulties.

* * *

Harry B. Archinal, *associate-in-charge*.............Page 9
Paul G. Kuhnle, *affiliated architect*
Peschel & Associates
2017 Locust Street
Philadelphia 3, Pa.

Solar energy is collected by water-filled panels, set both hori-

zontally and at the optimum solar insolation angle. Heated water is stored in a 7 by 17 ft storage tank with a capacity of 5,000 gal, located under the utility room. Copper tubing in the front slab of the house conducts the heated water from the storage tank, and thermostatic control is employed. An immersion heater is proposed to supply auxiliary heat for periods of abnormally low insolation, and domestic hot water is provided from the storage tank. Heat loss is expected to be 1,080,000 Btu per day, while summer heat gain will be 800,000 Btu per day. Native materials of redwood, stone, and tile are proposed. Adjustable jalousies are set behind the solar collectors on the north face of the supported bents, to create a chimney effect and to cool the residence. The collector arrangement maintains a low silhouette "without cluttering the south facade of the house with solar-collecting apparatus".

* * *

Jesus M. Artiaga, *architect*................................Page 10
Rodney E. Neujahr, *designer*
815 Hubbell Building
Des Moines, Iowa

Water-heating solar collectors are provided at a 60° angle on the roof of the house, while the swimming pool collector angle is set at 45°. Solar energy storage is provided in the form of a water tank beneath the cylindrical equipment-and-instrument room. A heat pump is included to provide auxiliary winter heat and summer cooling. With ample insulation throughout and Thermopane-glass sliding doors, the maximum predicted heating load is 50,808 Btu, while the predicted cooling load is 32,463 Btu per hour. Mechanically operated horizontal aluminum jalousies in the south overhang, fixed horizontal wood louvers in the north overhang and roof openings, and a screen of wood and opaque colored glass constitute the shade-creating devices. The swimming pool cover employs modular laminated wood frames to carry the solar collection surface for heating the pool and providing shade from the summer sun.

* * *

W. Pope Barney, *architect*................................Page 11
Marian G. Barney, *collaborating architect*
2408 Girard Trust Building
Philadelphia 2, Pa.

Water-heating solar collectors of the aluminum panel type are mounted on a "heat wall," 100 ft by 12 ft, in the northwest corner of the plot. The collected heat is stored in a 7,500-gal tank below the instrument room. Radiant heat coils are used in the floors of the house, and the roof construction over the living room permits the installation of duct work for air conditioning. All sun-facing windows are hooded, and all walls, ceilings, and floors are fully insulated. It is estimated that the heat load will be 38,700 Btu per hour, while the cooling load will be 3.6 tons, or 43,200 Btu, per hour. The author of the design states, in part, "The heat collector must be susceptible of quantity production ... Its use must in no way limit the free play of architectural imagination in designing an environment for family life. We therefore conceive of the collector as a separate entity, skillfully integrated with the landscape design."

The jury commented that this plan had good scale and general disposition, but was not of a quality to be premiated. The solar adaptability seemed reasonable.

* * *

I. and G. Benoit, *architects*................................Page 12
François Mayer, *architect*
6, Rue du Cirque
Paris 6, France

In the words of the authors of this design, "The choice of an 'egg-shaped' house has been made because it was the 'organic form' which best met all of the requirements of the problem ... Furthermore, it is also a highly efficient tool for controlling the physical forces of the sun. The house is so planned that all of the important living, dining, and sleeping areas face south. Being the opposite of a 'box architecture,' the design structure could be compared to an umbrella with a hole in the center. Through that hole, it can absorb as much sunshine as needed."

Eleven flat-plate collectors are mounted on the curved roof slab, designed to create a structural rhythm. A liquid transport system is used, with water pipes placed between the vertical columns, to carry the water to and from the storage space, which is a well-insulated unit located beneath the center of the house and adjacent to the swimming pool. Radiant heating is used in the form of steel-pipe coils imbedded in the floor. Cross ventilation is provided to cool the house in appropriate seasons, and electrical refrigeration equipment is added for summer air conditioning. Maximum hourly heat loss in the winter is calculated at 55,000 Btu per hour.

The jury commented that this was a unique solution, but that the plans and elevations show the result of an arbitrary arrangement, and the solar collectors do not seem to be integrated with the house.

Ashok Bhavnani, *designer*................................Page 13
21 Park Place
Princeton, N.J.
Eric Van Der Water, *affiliated architect*

A hot-air collection system is used, with aluminum tube-in-sheet, covered with Polyflex 230, a thermoplastic sheeting. Heat storage is provided by a 1,200 cu ft rock pile tank, located beneath the west end of the house. The hot air is apportioned by a system of dampers and valves, so that part of it will also go to heat the water supply and part of it to heat the pool through radiant heat pipes in the pool floor slab. The solar collectors are erected at an angle of 56°30′ to the horizontal, and a total area of 970 sq ft is provided. It is estimated that the winter heat loss is 53,000 Btu per hour, while the summer heat gain is 31,200 Btu per hour. The area of the building is 1,635 sq ft. In the words of the author, "The design is an integrated unit composed of a solar heating mechanism, a system of sunshades, and a system of of ventilation, all tied together by one structure to form a large all-encompassing parasol."

The jury commented that the design is an interesting architectural expression, although it is too elaborate and expensive for construction within the $30,000 budget.

* * *

Donald E. Colucci................................Page 14
144 Raff Road N.W.
Canton, Ohio
P. P. Denwicz, *affiliated architect*

Three banks of adjustable louver-type collectors are provided along the south face of the house, with reflector pits to increase the insolation during the winter season. To provide summer shade over the patio, translucent material is supported by the beams which tie the house to the vertical collector area. The swimming pool and the carport are provided in a wing which runs to the north of the residence proper. The daily heat loss and heat gain are 840,000 and 600,000 Btu respectively. A total collection area of 620 sq ft is provided, and the author proposes to use double glazing in front of a tube-in-sheet configuration. The jury commented that the orientation, with the full glass showing unprotected to the south and collecting the summer sun, leaves something to be desired. The author provided adjustable sunshades and sunscreens to overcome the intense summer sun.

* * *

Davis, Brody and Wisniewski, *architects*........Page 15
220 East 23rd Street
New York 10, N.Y.

The authors propose to use adjustable louvers, which they term "solar-collector baffles," to provide shade above the central core of the house and to collect the solar energy. Additional smaller "baffles" are mounted in a staggered pattern above the pool and the patio. The jury commented that the plan, which turns attention inward to the terrace and the pool, is handled with dignity. The use of the solar collectors as sunshades also met with approval, but it was felt that the master bedroom was not well located. The total heat loss was estimated at 75,360 Btu, while the summer heat gain is expected to be 60,300 Btu per hour. A total of 1,090 sq ft of collector surface is provided, with 670 sq ft provided to heat the house, 120 sq ft for the domestic hot water system, and 300 sq ft allocated to pool heating.

* * *

Mogens Didriksen, *architect*................................Page 16
K. E. Sandkirk, *architect*
Lauravej 3
Valby, Copenhagen, Denmark
Jorgen Mathiesen, *engineer*

A single air-heating collector is provided on the roof, running east and west along the north side of the house, inclined at an angle of approximately 57° to the horizontal. The heat storage system consists of some 120 tons of broken rock placed under the living area, on both sides of the swimming pool. A heat pump is specified to provide refrigeration for summer cooling and auxiliary heat for winter periods when the insolation is inadequate. Domestic hot water and swimming pool heating are provided by air-to-water heat exchangers mounted on the utility core of the house. It is expected that the winter heat loss should not exceed 75,000 Btu per hour.

The construction is specified as a pattern of steel frames, with a highly insulated, built-up roof having a reflecting aluminum surface. All glass elevations are double-glazed, and it is proposed that the house be heated by a forced warm-air system with perimeter ducting in the slab and adjustable air-inlet registers in the floor. The jury felt that the house could be built within the cost limits, and they approved of the simple solar collector system, although they felt that it was somewhat obvious and overpowering in relation to the house.

* * *

Grover W. Dimond, Jr., *architect*....................Page 17
416 Endicott-on-Fourth Building
St. Paul 1, Minn.

In this design, the collectors are mounted above the roof, to provide an umbrella of shade and air for sun protection in the summer. The collectors themselves are specified as 4-ft prefabricated sections, which are supported above the roof on runner angles. The heating system is hot water, pumped into the collectors to a storage tank, with radiant heating panel coils in the slab. The estimated heat loss and gain for the building are 63,000 and 65,000 Btu per hour, respectively. The jury commented that the proposed system of solar collectors was at a good scale and suited to the house, although the elevations and the plan were not consistent.

* * *

Thaddeus J. Dulemba, *architect*......................Page 18
75 College Avenue
Rochester 7, N.Y.

The author proposes to use a battery of adjustable louvers, mounted above the patio, which runs along the north side of the house. Glass is used extensively on the north and south sides of the house, but good insulation is proposed. The author specifies the use of water or other liquids as a collecting medium, and he suggests that the storage tank be buried in a sand pit at the northwest corner of the house. The jury commented that the system of collectors was excellent, but they questioned their location on the north side of the house where they produce shade in the winter time when it is not needed. They also believed that a considerably greater overhang would be needed to protect the living area from the sun in the spring and fall.

* * *

Manuel D. Dumlao, *architect*..........................Page 19
Cranbrook Academy of Art
Bloomfield Hills, Mich.

The author has mounted the house above twin reflecting pools, with the swimming pool and carport under a shelter mounted on the north side of the house. Flat-plate collectors are mounted on the roof in a horizontal arrangement. A collector area of 2,040 sq ft is provided to take care of the domestic water, space heating, and swimming pool heating. The roof is designed to provide ventilation, thus guarding against excessive warmth in the summer. Well insulated walls and roof reduce the heat gain and loss to 32,246 and 51,722 Btu per hour, respectively.

* * *

Clive Entwistle, *architect*........................Pages 20 & 21
1 Hamilton Mews
Park Lane
London, W.1, England

These designs, which arrived after the jury had met, are included because they present a number of unique features. On page 21, a tiltable flat-plate collector is shown, mounted on the roof towards the north side of the house. Three sections of collector are provided, and the author has shown details of their construction. Additional sections show an ingenious solution to the problem of selective shading, adjustable louvers, etc.

The design shown on page 21 is similar in plan to that on page 20, but a scanning parabolic collector is proposed, mounted above a heat-storage cylinder which is located beneath the central core of the house. The author proposes to use a lithium bromide absorptive refrigeration system, which is feasible because of the use of a concentrating collector rather than a flat plate. He suggests a sliding roof over a garden court, to provide sunshine when it is available, and to form a shelter when this is needed. Interesting details of solar shutters and "interference glazing" are also shown.

The total daily requirement of heat for space heating and domestic hot water is estimated at 580,000 Btu, and an additional 290,000 Btu would be needed to maintain the swimming pool at a satisfactory temperature on all days when the air temperature exceeds 45°. Two other sets of drawings were submitted, showing the plot plan and additional details of the parabolic collector.

* * *

William E. Evans..Page 22
1626 West Gardenia Drive
Phoenix, Ariz.

A combination heating system is proposed, using both circulating air and water. A collector area of 620 sq ft along the slanting south wall of the house is used to heat air, and storage is provided in a bin located in the central core of the house behind the instrument room, which houses the refrigeration unit, etc. A water collector area of 160 sq ft is provided for the domestic water requirements, and another 320 sq ft of collector surface is provided for warming the swimming pool.

A refrigeration unit is used for summer cooling and reverses to serve as a heat pump during the winter for auxiliary heating. Adjustable vertical louvers are provided on the west side of the patio to give shade for the swimming pool. The author further provides that the sun can either be admitted or excluded from the pool and patio area, while a plastic cover can be hung over the pool and supported by columns to reduce heat loss through absorption.

The principal feature of the house is the use of a large solar collector at an angle of 57°30′ to constitute the south wall of the residence. Heat loss and gain are calculated as 39,786 and 24,056 Btu per hour, respectively.

Leland Lewis Evison, ***architect*** ....Page 23
382 South Oakland Avenue
Pasadena, Calif.
Jack Lester, ***designer***
A. L. Ottum, ***engineer***

In this design, the house is situated with its back to the wind and the westerly sun and its face to the southeasterly sun. Quoting from the authors' descriptive material: "The house is heated and cooled radiantly by a system completely powered by solar energy. This system has been engineered and based on existing radiant heating and cooling installations built by one of the authors. Basically, the mechanical system features the collection of solar energy using parabolic mirrored collector surfaces to secure a high storage temperature."

Solar collection areas of 600 sq ft, consisting of 100 units, 12 in. wide and 6 ft long, are installed along the roof of the carport and the south-sloping roof of the house. Water is used as the heat-collecting and storage medium, with the storage tank buried beneath the carport. Screened louvers are provided to shade the patio on the south side of the house.

The authors advocate the use of ceiling panels for radiant heating in the winter and radiant cooling in the summer, and, in their experience, it has not been necessary to go below the dew point at peak load conditions. They also advocate the use of radiant panel coils imbedded in the concrete at the bottom of the swimming pool, in which 160° water from the solar collectors would be used directly. The maximum heat load is expected to be 60,000 Btu per hour, and the total heat gain is calculated at 69,800 Btu per hour. Of this, 32 per cent is gained through the roof, but is absorbed by the intervening ceiling panel.

The jury commented favorably on the openness of the plan and the protection of the rooms by the wide overhang of the roof. They were also impressed by the unique solar collection system, but they commented adversely on the fact that the pool is cut up by screens, walls, and the instrument room.

* * *

R. G. Fitzhardinge, ***architect*** ....Page 24
19 Beecroft Road
Pennant Hills
Sydney, Australia
K. G. Coles, ***solar heat consultant***

A combination system is used in which hot-air collectors are used to supply the heat requirements of the residence, with a major portion of the roof being used for this purpose. Storage is provided by an ingenious system in which an air tank, partially filled with adobe blocks, lies beneath the bedrooms and bathrooms. Domestic hot water is provided by an inclined heater, above which is located a 200-gal storage tank formed by a single 30-ft long, 12-in diameter, copper pipe, with a 1½-in. insulation.

Louvers are used to give shade to the patio area, or to reflect sunlight to this area in the winter. The author states: "Space heating is provided by means of a collector in the roof, inclined at 60° to the horizontal. Air is drawn through this collector and down the concrete block ducts in the adobe walls, which become low temperature radiators. As these walls contain 50 tons of material, the heat stored would be considerable. Air then passes through the 'air tank' and heats the adobe honeycomb in it. The kitchen, and dining and utility sections are heated by gravity flow from the air tank. At night, as the temperature of the walls falls below a minimum, the fan is turned on, and there is a reverse flow back from the air tank through the walls to warm them". In summer, cool night air is drawn into the air tank and then blown up through the walls to cool them. Calculated total heat loss is 601,050 Btu per day.

The jury admired the skill with which the elevation and its details were carried out, but questioned the arrangement of the entrance area. They commented further that the design was unique in the use of the roof as an auxiliary heat collector and the walls as both radiators and heat storage.

* * *

Peter Leal Floyd, ***architect*** ....Page 25
William Harvey Wainwright, ***associate***
William Warren Ahern, ***associate***
23 Arrow Street
Cambridge 38, Mass.

Modular folded roof panels are used to support the collectors at nearly the optimum tilt, and to provide good natural ventilation to the under-roof space through the gables created by the folds. The roof unit is both surface and structure as well as support for the solar collectors. The designers specify the use of stressed skins of ½-in. plywood for the roof panel slabs, with the space between the plywood filled with thermal insulation. They point out that precast concrete could also be used. Twenty collectors, each with 60 sq ft of area, are proposed. The water-circulating systems are provided in the beams immediately below the roof. The pumping equipment and heat storage reservoir are located under the paved patio living area, adjacent to the instrument room. The swimming pool, which is located in the central court, is shaded to some extent by the open-work wall on the south side, and also by a velarium which is stretched from the free-standing columns across the whole pool area. The authors point out that this sheltered location of the pool minimizes maintenance requirements.

Winter heat loss and summer heat gain are calculated to be 45,600 and 63,000 Btu per hour, respectively. In the opinion of the jury, this is an interesting, symmetrical plan, although somewhat too rigid and small.

* * *

Jack Freidin, ***architect*** ....Page 26
342 Madison Avenue
New York 17, N.Y.

Multiple roof-mounted collectors are provided, mounted at an angle of 60° over the main portion of the residence. A collector surface of 840 sq ft is proposed, and the author suggests that heat storage be provided by running the heated water through a material such as Glauber's salt, using the heat of fusion principle. A flexible sunshade is provided over the pool. This consists of covers of nylon fastened to rods spanning the space between the beams. Movable sunshades are also proposed on the east and west elevations.

Winter heat loss and summer heat gain are estimated at 54,000 and 51,000 Btu per hour, respectively, at the time of maximum load. Conditioned air is introduced into the rooms through supply grilles located around the outer periphery of the house.

* * *

Charles E. Gathers, ***architect*** ....Page 27
1508 East Humphrey Street
Birmingham, Mich.

Horizontal flat-plate collectors are used on the roof of the house, with a 1,000-gal storage tank and a 5,000-gal swimming pool to give reserve heat capacity. Louvers are used to control the flow of sunlight into the central core of the house. Seasonal shutters on the south act as an extended overhang. Trees and wood shutters are utilized on the east and west to minimize heat gain in summer. Winter heat loss and summer heat gain are estimated at 47,710 and 28,908 Btu per hour, respectively, at the design conditions.

In the opinion of the jury, the plan is compact and circulation is good. The treatment of the louvers and windows was considered to be somewhat arbitrary, and it was felt that the skylight might prove to be uncomfortable in summertime.

* * *

John Palmer Hardwig ....Page 28
211 E. Ontario Street
Chicago 11, Ill.
Schmidt, Garden & Erikson, ***affiliated architects***

The author of this design has used flat-plate collectors mounted on an inclined roof. A warm-air system is used to heat the house, while the domestic hot water and swimming pool requirements are handled by a liquid system. Total heat loss is estimated at 40,277 Btu per hour in the design conditions. A unique feature is the use of polaroid discs for living room windows, which make provision for darkening the room when this is desired. Controlled dome-type skylights are used in part over the living room.

The jury commented that the system of controlling the sun appeared to be rather complicated and expensive, although the plan of the house works well and seems to be economical.

* * *

Russell Hastings, ***architect*** ....Page 29
199 East Toole Avenue
Tucson, Ariz.

The inclined portions of the south elevation of the house are used as solar collectors, and the author proposes to use highly reflective surfaces in front of all collectors, to prevent the growth of grass, weeds, etc., and to increase the heat absorption over the calculated amount. Swimming pool heat will be provided by a vertical collector mounted on the wall north of the pool, and here again a reflective horizontal surface is used on the ground to increase the amount of heat which can be absorbed.

The north and east walls of the kitchen and living room are built of 8-in. stone masonry for architectural effect. The floor is poured-concrete radiant slab on sand fill, with perimeter insulation. Under summer conditions, the overhangs provide virtually complete shading. Winter heat loss and summer heat gain are calculated at 33,090 and 26,970 Btu per hour, respectively.

Individual heat storage and circulation systems are used behind each of the collector panels. The location of the swimming pool and the provision for a heat-collecting wall results in a house which has its attention directed inwardly. Individual zone refrigeration units located in the space behind the collectors makes a separate equipment room unnecessary.

* * *

Marvin Hatami ....Page 30
D. R. Roggenbach, ***affiliated architect***
James Sudler Associates
1730 Glenarm Place
Denver 2, Colo.

Adjustable louvers over the south patio provide 800 sq ft of collection area, while a vertical screen on the south side of the swimming pool provides 248 sq ft of additional area. Heat storage is furnished by a sunken water tank, lined with concrete and insulated by mineral wool and concrete block. A heat pump is used to provide auxiliary heat and summer cooling. Estimated summer and winter cooling and heating loads are 77,740 and 66,750 Btu per hour, respectively.

In the opinion of the jury, the house has a good system of collectors and an interesting plan, but it is somewhat marred by the detailing and variety of textures, fences, and elevations.

* * *

C. Harrison Hill, Jr., ***architect*** ....Page 31
2 Highland Drive
Milltown, N.J.

Solar heat collectors occupy most of the south walls, replacing them and eliminating their cost. Standardized collectors, 4-ft wide and 10-ft high, are used, with water as the circulating medium in blackened, tube-in-strip collector plates. A single sheet of glass is used to cover the collectors, and their backs are insulated with three air-spaced layers of reflective insulation which are covered with plywood, forming the inside wall of the rooms. At the design conditions, winter heat loss is expected to be 55,000 Btu, while summer heat gain is 28,000 Btu per hour.

The carport roof shades the glass area on the east side of the house, while foliage in the courtyard shades the west side. Heat-of-fusion-type storage, holding 10,000 Btu per cu ft, is employed. It is proposed that this heat storage material be located at the inside base of the solar heat collectors, where heat is transmitted by radiation and forced air circulation, thermostatically controlled. It is further proposed that night-sky radiation emitters be located on the flat roof, which will circulate cooled air into a heat storage system, to minimize the daytime cooling load.

The jury commented that the author had made good use of his inside space, but they felt that the plan was somewhat difficult in circulation and livability.

* *

Wilhelm Holzbauer, ***architect*** ....Page 32
"Arbeitsgruppe 4"
Fuhrmanngasse 4
Vienna 8, Austria
Present address:
Dept. of Architecture
University of Manitoba
Winnipeg, Man., Canada

The solar collectors, combined with skylights, serve as the roof for the important rooms of the house, while the areas of lesser importance (bathrooms, storage, etc.) have a low, flat roof. A water storage tank of 5,000-gal capacity, placed between the living and sleeping rooms, serves as the heat storage unit. Louver frames of varying horizontal extensibility give sun control on the southern exposure. The swimming pool is served by two separate solar collectors, which also enclose a private sun-bathing terrace. Fabric mountings attached to the permanent pergola minimize winter heat loss from the pool. Heat loss from the house under winter design conditions is calculated at 52,000 Btu per hour.

* * *

James W. Hopkins, ***architect*** ....Page 33
920 Jefferson Avenue
New Orleans 15, La.

The author proposes to use inclined collectors along the south face of the building, running vertically the entire length of the side. A storage tank is provided beneath the surface of the lot, on the east side. The swimming pool is situated in the central court, so that it is visible from the living and dining area. Complete symmetry is expressed in the design, and louvers are used on the east and west faces of the house to provide sun control. The author estimates that the total heat loss from the house at the design conditions would be 90,524 Btu per hour, but the solar heat gain through the glass south wall would be 30,200 Btu per hour, thus reducing the heat loss to 57,325 Btu per hour. A total of 1,050 sq ft of collector area is provided to achieve the necessary solar heat collection.

* * *

David N. Hunt, ***designer*** ....Page 34
John E. Stephens & Associates, ***affiliated architects***
603 North 3rd Avenue
Phoenix, Ariz.

The house is located so that its long axis is directed from southeast to northwest. The carport provides shade and privacy at the southeast corner of the house, while screens and louvers provide similar protection on the south and west elevations. Solar-collecting louvers are mounted on frames separated from the main house by a garden area. These provide complete shade for the south-facing wall of the house. The winter heat loss is estimated at 35,858 Btu per hour, while summer heat gain is expected to be 21,859 Btu per hour.

The jury's report stated that the house was well liked and the

collectors as shown should be effective for winter weather. The scale is excellent but the plan leaves something to be desired.

* * *

William R. Jenkins, *architect*..........................Page 35
4900 Travis Street
Houston, Texas

The author of this design has used a vertical wall along the south elevation of the house as the location for his collectors. He proposes to use a water storage system, with an insulated tank located in the equipment room. A 1500 CFM vertical air-handling unit, split into two zones, will supply air overhead to the living area and the bedroom area alternately.

Shading is provided by horizontal louvers which surround the living area and swimming pool. Since the walls of the house are largely made of glass, the author recognizes that the summer heat gain and winter heat loss will be 79,100 and 108,000 Btu per hour respectively. He proposes to reduce refrigeration requirements by using the collector system as a heat rejector at night and storing chilled water in the storage tank.

The jury commented that the architectural conception was very interesting, although it is probably too expensive for execution within the budget. It seems difficult to explain the elaborate shading, particularly on the north side of the house. The vertical collectors would undoubtedly work well during the winter.

* * *

Roy Latham, *architect*..Page 36
G.M.T.G. Simpson
57 Tany's Dell
Harlow, Essex, England

The principal element which strikes the eye in this house is the solar collector, which is inclined at an angle of approximately 30° to the horizontal, above a bonded wood frame. Approximately 1,040 sq ft of collector surface is provided, with a 6,250-gal rectangular collector tank located beneath the equipment room. Swimming pool heating will be provided by circulating water from the main storage tank through a pipe coil around the sides of the pool.

A warm-air heating system is proposed, with the air being supplied to the rooms through high velocity slot grills discharging upward through the window sills.

The solar heat collector serves as the roof for the carport, the heat storage room, and the living area, and it provides shade for the outside living area and the south end of the swimming pool. Further shade is provided by louvers on the east and west walls.

The jury commented that the authors have designed a compact house with a very efficient use of the collector, although it is somewhat overpowering structurally.

* * *

Enrique Limosner ....Page 37
2530 Ellsworth
Berkeley 4, Calif.
John C. Farrell, *affiliated architect*

A horizontal collector surface of 2,040 sq ft is located on the main house roof. Space heating is provided by warm air, with a gravel pit under the elevated living room for heat storage. Heat will be distributed by radiation through the hollow tile floors.

The house is placed within a canopy of open web joists 6 ft on centers, supported by pipe columns with added welded flanges. These parts would be shop-fabricated and erected on the site with high tension bolts. The roof deck, apart from a peripheral walk of concrete and Porex planks covered with canvas roofing, is composed of flat-plate solar heat collectors, metal flashed. The author calculates that the heat loss and gain, at design conditions, will be 77,850 and 46,250 Btu per hour respectively.

The jury commented that the author had proposed an interesting architectural scheme, but one which was too elaborate and expensive for execution within the budget. They commented favorably upon the appearance of the free-standing element within the swimming pool, but questioned the wisdom of its location.

* * *

Pershing C. Lin..Page 38
855 Sacramento Street
San Francisco, Calif.
Amedeo Leone, *affiliated architect*

The collectors are mounted on the south-facing areas of steeply slanting roof elements. The author suggests the use of laminated wood bents as the columns, in order to achieve a simplified "stem" effect, connating an impression that the structural system of the residence is "reaching up for solar energy." A buried water tank is used for heat storage, and individual, cylindrical dressing rooms are provided at the south side of the swimming pool. The author proposes to use the system suggested by Dr. Austin Whillier at the 1955 World Symposium on Applied Solar Energy. Heat loss for the residence in winter is estimated at 51,800 Btu per hour, while heat gain in summer, making allowance for large overhangs, is expected to be approximately 40,400 Btu per hour.

George Kazuo Matsuda, *architect*...................Page 39
667 East 232nd Street
Bronx 66, N.Y.

The author proposes to mount the house upon a podium, so that water tanks can surround it completely. The "saw-toothed" roof-form carries heat collectors of the flat-plate, water-circulating type. A storage tank is provided beneath the utility room. Radiant heating is effected by coils imbedded in the concrete floor slab.

It is proposed that the house be constructed largely of wood and glass, with perforated screens to give shading and privacy.

* * *

James A. Nash..Page 40
3 Shippen Street
Weehawken, N.J.
Alan Ballou, *affiliated architect*

The author proposes to use 700 sq ft of collector area inclined at an angle of 50° from the horizontal and mounted above the roof in five sections. Two sections run the entire length of the house, while three more sections run across the roof which is provided above the patio and carport. These latter sections furnish 300 sq ft of collector area for tempering the swimming pool. An adjustable shade is provided for the swimming pool, and shade is also offered to the patio area by rolling wooden screens.

A liquid transport system is provided, with a water storage tank buried under the utility room. The estimated heat loss and heat gain are 110,000 and 130,000 Btu per hour, respectively. Overhangs are provided to afford the necessary shade on the south, east, and west elevations.

* * *

Victor Olgyay, *architect*...................................Page 41
84 College Road
Princeton, N.J.

A unique system of heat collection is provided by means of deflectors which turn the sun's rays downward through double plastic glass to a floor of glass blocks. Heat storage is provided by means of concrete blocks in the air space between the glass brick floor and an insulating concrete subfloor. The overhang on the south side of the house shuts out the summer rays but allows deep penetration of winter sunlight.

The domestic hot water system is provided by a conventional vertical collector, while heat for tempering the pool is provided by a vertical collector mounted on a wall to the north of the pool. During the winter, heat loss at the design conditions is expected to be 35,395 Btu per hour, while during an average winter hour the heat loss will be 21,040. The total heat gain at the summer design conditions will be 22,886 Btu per hour.

The jury felt that the author had evolved a compact and acceptable plan. They questioned the livability of the proposed solar heating system, which would create a difficult insulation problem.

* * *

Oscar R. Padjen, *architect*...............................Page 42
8 Prospect Street
Beverly, Mass.

Vertical collectors are proposed, located in walls which extend along the south side of the house, with two additional collection areas, one being mounted above the roof, while the other appears as a fascia at the top of a vertical wall. An insulated underground storage tank is provided, and conditioned air is circulated through the house by means of branched perimeter underground ducts. Cooling is achieved by mechanical refrigeration, using the same ductwork. As an alternate system, the author proposes to use hot water directly for slab radiant heating with ceiling ducts for cooling. Heat gain and heat loss are estimated at 60,000 Btu per hour. Sunshades and winter wind protection are provided for the swimming pool by means of pressed-wood frame bents and movable plasticized fabric.

The jury felt that the proposed collector system was commendable, but commented adversely on the circulation within the house.

* * *

Neville D. Quarry, *architect*...........................Page 43
32 Park Village East
Regents Park
London, N.W.1, England

Flat-plate collectors, tilted at an angle of 60°, are mounted along the south elevations of the house and above the east-west section of the house, which lies to the north of the swimming pool. The total collection area is 1,026 sq ft, of which 606 sq ft are allocated to space heating, 120 sq ft to domestic hot water, and 300 sq ft to tempering the swimming pool. The author proposes a heat storage bin, 4 by 4 by 8 ft, containing 1½ in. of gravel and three coils of water pipes. One coil is to be used to heat the domestic water supply, one coil supplies heating panels in the floor of the residence, while the third coil is connected to the collector plates. It is proposed that an evaporative water cooler be used at night to chill water which would be stored in a tank. Ceiling panels are used for cooling the house. Heat loss and heat gain are estimated at 26,000 and 53,000 Btu per hour, respectively.

The jury commented that the author had made a very determined and forward use of collectors, which tend somewhat to overpower the house.

* * *

John B. Reed, Jr., *architect*.............................Page 44
1332 Stanford Drive N.E.
Albuquerque, N.M.

An inclined collector mounted boldly at the south of the house provides the means for heating water which is stored in an insulated underground tank. Shading of the southern exposure is provided by the carport, by the collector itself, and by window overhangs. Vertical collectors along the east and west sides of the house provide shade, but openings are furnished so that occupants of the house can take advantage of the views. The entire area of the house and the living area in its vicinity are enclosed within walls to give the necessary privacy. Heat loss and heat gain are estimated at 69,000 and 64,000 Btu per hour respectively. Heating and cooling are to be accomplished by a radiant panel ceiling.

The jury commented that the design was well presented and contained an interesting plan. It was felt that there was some inconsistency in the treatment of elevations, and that the scale of the collector was somewhat obvious with respect to the size of the house.

* * *

Lisbeth Reimmann, *architect*............................Page 45
Mühlebachstrasse 84
Zürich 8, Switzerland

This entry, which was received in Phoenix too late to be judged by the jury, is included because of the interesting features which it contains. A large collector provides shade above the living room and is used for heating both air and water. A gravel-filled storage bin is provided in connection with the space-heating system, while water coils are used to heat the domestic water supply. The swimming pool is heated by 600 sq ft of horizontal surface, mounted on the earth to the north of the pool.

* * *

Linton W. Reynolds...Page 46
Alan G. Hough
6 Arcadia Avenue
Oakleigh, Melbourne, Australia

Water-heating collectors form a section of the south wall of the house, the south side of the main roof, and the sunscreen over the swimming pool. An area of 600 sq ft is provided in the vertical plane, 500 sq ft in the horizontal plane, and 1000 sq ft in a plane at 5° to the horizontal. A horizontal surface of 240 sq ft is allocated to hot-water heating, with a 400-gal cylindrical storage tank. A 4500-gal underground insulated tank will provide heat storage. The refrigeration plant which is used for cooling in the summer will supply auxiliary heat in the winter by acting as a heat pump. The authors propose that the source of heat for heat pump operation should be a buried collection coil, covering an area of approximately 50 sq ft, 2 ft below the surface.

In the opinion of the jury, the authors propose a good, compact plan, but their collector system is somewhat overpowering and not well related to the house.

* * *

Harry Rice...Page 47
7044 Orange Blossom Drive
Scottsdale, Ariz.
Donald T. Van Ess, *affiliated architect*

The author makes extensive use of a reflecting pond which serves also as a heat storage tank for winter operation. During "heat-demanding months," the storage pond is completely covered by 4 in. of Siporex concrete panels. These panels are removed for summer operation, so that the house becomes, in effect, an oasis. Inclined heat-collecting panels are provided along the south wall of the house, and wide overhangs prevent the summer sun from reaching the glass surfaces on the south and west sides of the house.

The jury expressed the opinion that the plan was interesting, but they felt that it would be too expensive to build within the alloted amount. They expressed approval of the location of the collectors for winter operation.

* * *

Peter Rounds, *architect*...................................Page 48
1849 Robson Street
Vancouver, B. C., Canada

The author of this curved design has provided horizontal flat-plate collectors, mounted on the roof of the house. He comments that this configuration was chosen because the collectors would serve as insulation and, in the future, would be particularly effective for summer cooling purposes. Over the barbecue terrace, adjacent to the swimming pool, adjustable reflective plastic awnings are provided, supported by tubes through which hot water is piped to temper the barbecue area on chilly evenings. The author has used much glass, and he proposes to heat the house with radiant ceilings. With Thermopane glass, the winter heat loss is calculated to be 48,850 Btu per hour. With single glass, it is estimated to be 76,400 Btu per hour.

The use of horizontal collectors on the flat roof permits the author to use his proposed curved design, in which, as he points out, all walls are actually in straight lines.

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Prasom Rungsiroj, *designer*..............................Page 49
W. Pope Barney, *architect*
2408 Girard Trust Building
Philadelphia 2, Pa.

The solar collection area is provided by aluminum panels, mounted on reinforced concrete standards, at an angle of approximately 60° to the horizontal. These collectors run along the front of the house and extend to a considerable height. In the opinion of the author, mass production could be used to make the individual segments of the collector available at moderate price. Heat storage is provided by an 8,000-gal tank mounted over the multipurpose room in the bathroom wing. The sun exposure walls of the house itself have projecting sunshades or protective planting.

The jury found this to be an interesting design, but they felt that the collector was badly placed in relation to the house.

* * *

Kaj Schmidt, *architect*......................................Page 50
Carinavej 2o
Aarhus, Denmark
Helge Nygaard Andersen, *architect*
Sylvain Thomsen, *engineer*

The house itself is constructed between two heavy parallel walls, running east and west. These walls would be composed of 10-in. Siporex blocks, with 4-in. air spaces filled with rock wool. The collectors would be vertically disposed along the south side of the house, and louvers would be provided above a swimming pool which is located within covered work-and-play space. Adjustable vertical louvers on the east side of the house, and shutters on the west side, provide sun protection.

By using the south wall itself as the collector, the author expects to obtain economy in construction and a lower ultimate heat loss. A total of 1,170 sq ft is provided, to collect 550,000 Btu for space heating on a normal winter day, and also to give 138 sq ft for domestic hot water heating and 345 sq ft for tempering the swimming pool. A 5,900-gal water tank is used to give a two-day heat storage. Heat loss in winter is expected to be 43,410 Btu per hour, while summer heat gain should be 26,970 Btu.

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Salvatore Scutaro...Page 51
20-64 24th Street
Astoria, N.Y.
Alvin Hausman, *affiliated architect*

Water-heating collectors are mounted in eight rows, supported by steel-work above the roof of the house. The liquid transport system is used in order to give a quick response to the system. For heating and cooling, the author uses a split system of forced air and radiant panels. Maximum heat loss in winter is estimated at 65,280 Btu, while the maximum summer heat gain is expected to be 55,700 Btu. The collectors provide a total of 1,240 sq ft, tilted at the optimum angle of 57°30′. The swimming pool is mounted within the house area so that easy supervision can be maintained at all times. Adjustable louvers are provided to give shade on the west side of the pool area, and a provision is made for a retractable polyethylene cover which can be stored in an area on the east side of the pool. A wide overhang protects the glass walls of the living, dining, and kitchen area.

The jury commented that the author had provided an interesting solution to the collector problem for both summer and winter, and that they felt his plan was logical.

* * *

George Ryuso Sera...Page 52
Pierre Cabrol
Jacques Binoux
17 Sacramento Street
Cambridge, Mass.

"The use of an independent structure ("A" frame) for collecting solar energy frees the house from being constructed by the collecting surfaces. Without disguise, the batteries of collection surfaces, set at the optimum angle of 56°30′, express the fact that this is a solar house." The arrangement of the collectors creates an interesting pattern on the facade and the ground; it also allows the low winter sun to penetrate into the living room.

For economy of material and economy of operation, the house is planned around the core of kitchen, utility room, and bathroom. The roof over the bathroom and utility area is a trough of waterproofed, concrete shell, for beds of low-growing shrubs and flowering plants. The layer of earth and plants serve as good insulation against heat and cold and create a pleasing roof surface. The thesis of this design is based on the fact that the temperature under ground is more constant than that above ground. By excavating and by using the excavated earth to form a bank around the house, the architect has created varied levels and interesting spaces and landscapes, while giving more privacy to this flat corner lot.

* * *

Paolo Soleri, *architect*.......................................Page 53
Rt. 2, Box 266
Scottsdale, Ariz.

Solar collectors, 900 sq ft in area and inclined at 30° to the horizontal, constitute an important portion of the roof of the house. The earth is raised around the residence to eliminate the danger of floods and portions of the roof are also covered with earth, so that planting may be applied over these areas. The living and sleeping areas of the house look towards the swimming pool, which is located on the south side of the house, between the two wings. Provision is made for both indoor and outdoor fireplaces.

The jury commented that the author had proposed an imaginative solution, utilizing the earth's contouring to good advantage. They felt, however, that the structure would be expensive to construct, and they questioned the acceptability of the living pattern.

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Reiner A. Stein, *designer*...............................Page 54
638 South Manhattan Place
Los Angeles 5, Calif.
Thomas Wilkins Cowie, *affiliated architect*

The author makes use of an east-west orientation, with precast triangular-shaped panels, on 20-ft centers, which receive concrete tie beams and horizontal collecting headers within which the warm air distribution ducts are located. The collectors are located above the roof, inclined at an angle of 56°30′ to the horizontal. A 12 ft 6 in. overhang towards the south, provided with adjustable louvers, admits the winter sun but shuts out the summer sun. A gallery along the north side of the house provides circulation, and the necessary heat storage is furnished by three vertical tanks, each with a capacity of 740 gal. The swimming pool is located at the south of the house and is sheltered by a wall.

The author estimates that the heating and cooling loads are 51,940 and 31,405 Btu per hour, respectively. He anticipates that, with 1,000 sq ft of plastic-film-covered flat-plate collectors, he can collect 1,200,000 Btu on a normal winter day.

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F. S. Toguchi, *architect*....................................Page 55
19765 Maple Heights Boulevard
Maple Heights, Ohio
Richard J. Fleischman

Heat collection is accomplished by four curved panels, which run north and south above the house. The architect thus provides shade and "establishes a double function for this architectural form which in itself creates new spaces, exciting and comforting." Heat storage is provided by a water tank, buried beneath the main entrance. Auxiliary heating and cooling is furnished through a forced-air system from the unit in the utility room, with ducts in the crawl spaces and a main tile duct underground to the north crawl space. Relatively flat collectors have been used to create the desirable amount of shade for the roofs and garden area. By building a "roof on roof," heat gain has been minimized. The heat loss is calculated to be approximately 60,000 Btu per hour, and the heat gain to be 45,000 Btu per hour.

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Gene E. Trotter, *architect*................................Page 56
219½ North Broadway
Billings, Mont.

The roof of the house, inclined at an angle of 15° to the horizontal, provides 1,480 sq ft of collector area. Air was selected as the collection medium, for reasons of economy and water conservation. The sloping insulated roof deck is covered with aluminum foil. Stock skylight members are fastened to the deck to form air passages, as well as to support covers of metal painted dark green and glass covers above the metal. Skylight members have integral "T" projections above the glass at intervals to support temporary walks for construction and repairs.

Heat is stored in small containers of Glauber's salts arranged in open drums which revolve as necessary to prevent stratification. Heated air from the collector enters the top of the storage bin and leaves the bottom to enter the air-handling equipment and duct system. The storage space also contains coils for heating domestic water and swimming-pool water. There is sufficient volume of salt (200 cu ft plus 30 per cent voids) to provide storage of 2,380,000 Btu, which is more than sufficient for two days' heating requirements.

Warm air is circulated above all ceilings in passages formed by the insulated roof deck, the roof joints, and the ceiling. This air is delivered into the rooms at the end of the passage next to the exterior wall. Central returns deliver it to the heat source for recirculation.

There are horizontal adjustable louver sunshades over the master bedroom, garden, patio, swimming pool, and carport, and vertical adjustable louvers at the west end of the patio. Heat loss and heat gain are estimated at 51,258 and 67,000 Btu per hour, respectively.

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Waldron & Dietz, *architects*............................Page 57
215 8th Avenue North
Seattle 9, Wash.

Flat-plate water-heating collectors, 1100 sq ft in area, are located along the length of an "A" frame tilted at an angle of 60° from the horizontal. The heated water is collected in an insulated cistern located under the utility room floor. The calculated heat load is 78,000 Btu per hour; the cooling load, based on the average daily temperature, is three tons (36,000 Btu per hour). The authors propose to use electric wall heaters in all bathrooms and electric strip heaters in the air conditioner for standby use. A package water chiller is piped to the cistern for summer air conditioning, and is valved to serve as a heat pump for a booster unit, with the cistern storage as a heat sink.

The jury commented that the solution was interesting, but the collector seemed somewhat overpowering and the over-all execution perhaps too expensive.

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Eugene A. Wedell, *architect*............................Page 58
2420 Charnelton
Eugene, Ore.

An air transport system is used, with glass-covered flat-plate collectors set at an angle of 45° on the roof of the structure. Extensive overhangs are provided which constitute the carport on the west and provide adequate shade on the east and south sides of the house. A cylindrical machinery room is provided on the north side of the house, and the swimming pool is enclosed by a structure which is similar to the residence itself.

Heat storage is accomplished by a gravel pit beneath the machinery room. Heat loss and heat gain are estimated at 50,850 and 29,670 Btu per hour respectively.

The jury commented that this is one of the more interesting inward-looking schemes, and that it has been done with a great deal of skill. The feeling was expressed, however, that it would be dark and difficult to circulate.

* * *

Raymond J. Wisniewski, *architect*.................Page 59
77 Hickory Hill Road
Simsbury, Conn.

Bare roof-type tube-in-strip copper collectors, facing south and tilted at 56½°, are used to provide a total area of 1,160 sq ft of collector surface. The two roof panels are connected to a 5,000-gal insulated storage tank. The house is heated by warm air which is circulated through ducts, and auxiliary heat is provided by an electric heater. A heat pump is provided for some auxiliary heat in winter and for summer air conditioning.

The jury recognized the fact that adequate collection area was provided, but criticized the integration of the collectors with the house.

* * *

Hanford Yang, *designer*...................................Page 60
John N. Morphett, *architect and designer*
c/o Graduate School of Architecture
Massachusetts Institute of Technology
Cambridge 39, Mass.

Multiple prefabricated collectors are mounted on a supporting structure above the roof. They are inclined at a steep angle for most effective winter operation. A wide overhang gives protection from the summer sun to the glass areas of the living space. Louver-covered terraces and a pavilion close to the swimming pool are planned to provide generous shaded spaces for the enjoyment of outdoor living. The collection units above the high roofed area of the house are for domestic hot water and heating needs. The collectors on the roof of the pavilion are for heating the swimming pool. The V-shaped profile of the collectors provides for insulation and an air space, and the units are so placed that the least area of shadow is cast by succeeding rows of collectors. Water is used for the heat transport and storage medium, the storage unit being placed centrally within the house. The winter heat loss and summer heat gain are calculated to be 57,660 and 41,260 Btu per hour respectively.

The jury commented that, while not of premium quality, the plan is good and its adaptability to solar heating and cooling is feasible in terms of existing methods.

BIBLIOGRAPHY

The literature on space heating by solar energy consists principally of the four books listed below and a large number of articles which have appeared in the technical press since the early 1940's. The term "solar house" has been widely used to denote a residence in which large expanses of south-facing glass are used for winter heat gain, while overhanging eaves are used for protection against the summer sun. Reference 1 contains forty-nine different plans for accomplishing this.

The concept of a "solar-heated" residence differs from the "solar house" in that solar radiant energy is collected by any of a number of systems and transferred to a fluid, which is then used to maintain the residence at a comfortable temperature. Solar heat is also stored for use during the night and in daylight periods when the insolation is inadequate. Reference 2 is an exceptionally valuable compilation of fundamental data on the collection and utilization of solar energy for space heating. The papers in this volume represent work done prior to 1950.

Reference 3 presents a general summary of solar energy utilization as of September, 1953. It contains a 42 page section on solar heating and cooling. Reference 4, published after the Phoenix World Symposium on Applied Solar Energy, devotes more than 100 pages to both the architectural and technical aspects of solar house heating and cooling as these arts had progressed to November, 1955.

1. *Your Solar House,* 1947, Simon and Schuster, Inc., 1230 Sixth Avenue, New York. Compiled from contributions of forty-nine architects by M. J. Simon, with technical assistance from Libbey-Owens-Ford Glass Co. 125 pp., $3.00 per copy.
2. *Space Heating with Solar Energy,* 1954, Department of Architecture and Planning, Massachusetts Institute of Technology, Cambridge, Mass. The proceedings of the course-symposium held at Mass. Inst. of Tech., Aug. 21-26, 1950; edited by R. W. Hamilton, with discussion notes by Austin Whillier; 161 pp., $2.85 per copy.
3. *Solar Energy Research,* 1955, The University of Wisconsin Press, Madison, Wisconsin. Edited by Farrington Daniels and John A. Duffie from the proceedings of the symposium on the utilization of solar energy held at the Univ. of Wisconsin, Sept. 12-14, 1953. 290 pp., $4.00 per copy.
4. *Proceedings of the World Symposium on Applied Solar Energy,* 1956, Association for Applied Solar Energy, 3424 N. Central Avenue, Phoenix, Arizona. Text of all papers presented at the Phoenix Symposium, Nov. 1-5, 1955, edited by Charles Scarlott of Stanford Research Institute; 304 pp., $5.00 per copy.

Certain of the well-known solar-heating applications are described more completely in the foregoing books than in the general literature. The following cross-reference will be useful in finding descriptions of each:

The Dover, Massachusetts, house of Dr. Maria Telkes and Miss Eleanor Raymond, Ref. 2, pp. 95-97.

The Boulder and Denver, Colorado, houses of Dr. G. O. G. Löf, Ref. 2, pp. 72-94; Ref. 3, pp. 33-45; Ref. 4, pp. 131-145.

The Massachusetts Institute of Technology houses at Cambridge, Ref. 2, pp. 99-116; Ref. 3, pp. 47-56; Ref. 4, pp. 103-130.

The Donovan and Bliss house at Amado, Arizona, Ref. 4, pp. 151-158.

The technical papers on the collection and utilization of solar energy have been published in many periodicals. The Association's bibliography-directory, *Applied Solar Energy Research,* lists more than one hundred references which were published before December, 1954, and the Library of Solar Energy contains at least an equal number which have appeared since that time. The following references are selected because they are particularly important and are also readily accessible in libraries throughout the world. The listing is chronological.

5. "The Performance of Flat-Plate Solar Heat Collectors"; H. C. Hottel and B. B. Woertz; *Trans. Amer. Soc. Mech. Eng.,* Vol. 64, 1942, 91-104.
6. "Solar Energy Utilization for House Heating"; G. O. G. Löf; Report PB 25375, Office of the Publication Board, Department of Commerce, Washington, D.C. 1946.
7. "The Solar House; Analysis and Research"; F. W. Hutchinson; *Progressive Architecture,* May, 1947, 90-94.
8. "A Review of Solar House Heating"; Maria Telkes; *Heating and Ventilating,* Vol. 46, Sept. 1949, 68-74.
9. "Solar Energy; Past, Present, and Future Uses"; H. Heywood; *Engineering* (London), Vol. 176, 377-380, 409-411.
10. "Utilization of Solar Energy for House Heating"; J. L Threlkeld, and R. C. Jordan; *Heating, Piping, and Air Conditioning,* January, 1954, 193-201.
11. "Solar Collector and Heat Pump Heats, Cools New Office Building"; R. Haines, F. Bridgers, and D. Paxton; *Heating, Piping, and Air Conditioning,* October, 1956, 104-107.
12. The plastic materials mentioned on page 11 are not yet described in the literature. One such material is a transparent variety of Teflon which is mentioned briefly in the March-April issue of *Better Living,* which is published by the Public Relations Department, E. I. du Pont de Nemours, Inc., Wilmington, Delaware. A second material is described in specification sheets dated Feb. 1, 1955, issued by the Plax Corporation, P.O. Box 1019, Hartford, Conn.
13. The collection surface used in the Bridgers and Paxton Building in Albuquerque, New Mexico, (Ref. 11) was produced by the Western Brass Division of the Olin Mathieson Chemical Corporation, East Alton, Illinois. Similar panels are also produced by Reynolds Metals Co., Louisville, Kentucky.
14. The tube in sheet shown in Fig. 7 is produced by Revere Copper and Brass Inc., 230 Park Avenue, New York 17, N.Y.
15. Valuable information on sun control is included in the 1957 catalog of the Lemlar Manufacturing Co., P.O. Box 352, Gardena, California.
16. General information on the use of silicon solar cells for control and other low-power applications may be obtained from the Application Engineering Division, Hoffman Electronics Corporation, 3761 S. Hill Street, Los Angeles, Calif.
17. A summary of solar energy utilization is to be found in "Power from Solar Energy — Some Fundamental Factors," by J. I. Yellott; paper No. 56-F-15, presented at the 1956 Fall Meeting of the American Society of Mechanical Engineers.